ERRATUM

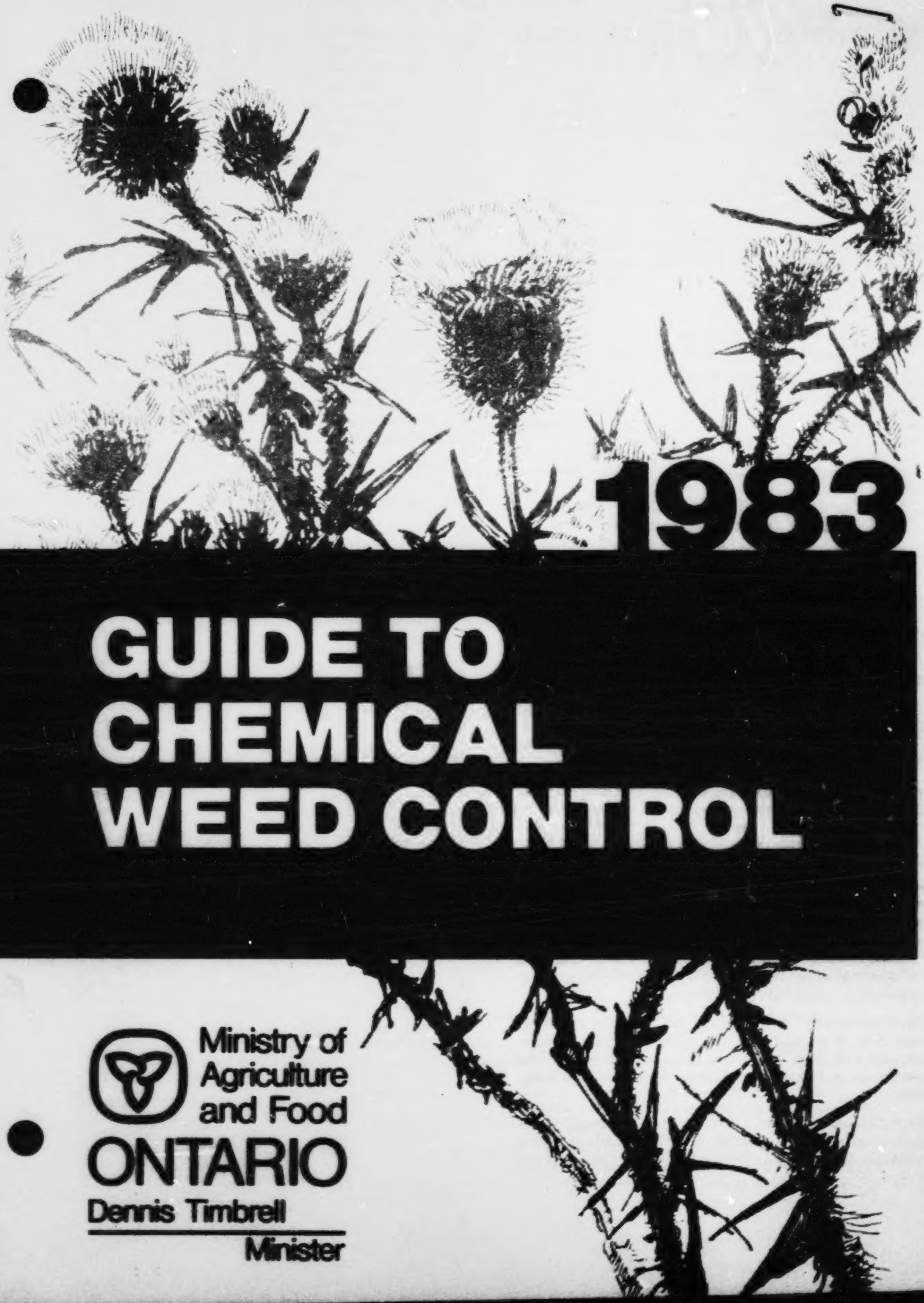
Publication 75 — 1983 Guide to Chemical Weed Control

A printer's error has been found in one section of this publication. The third section from the top on Page 8 - Table 1. Herbicides Used in Ontario (Cont'd) - should read as follows:

dichlorprop mixtures	See above (2,4-D/dichlorprop)			
diclofop-methyl	HOE-GRASS	EC	190 g/L	5.3
difenzoquat	AVENGE 200C	Sn	200 g/L	5.0
DINITRO	dinoseb	EC	300 g/L	3.4
		EC	600 g/L	1.7
		Sn	360 g/L	2.8
		Sn	600 g/L	1.7

Issued by the Communications Branch, Ontario Ministry of Agriculture and Food. 13/04/83

PUBLICATION 75



1983
GUIDE TO CHEMICAL WEED CONTROL

Ministry of
Agriculture
and Food
ONTARIO
Dennis Timbrell
Minister

EQUIPMENT

HORTICULTURAL CROPS

AGDEX 641

Prepared by

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This publication has been reviewed and is endorsed by the Ontario Pesticides Advisory Committee.

Your 1983 GUIDE TO CHEMICAL WEED CONTROL outlines the latest recommendations for the control of weeds by use of herbicides. Where these recommendations relate to the control of weeds in a particular crop they may be quite specific, and must be followed closely if control is to be obtained and damage to the crop avoided. Cultural, seeding and other operations may have to be adjusted to the spraying program for maximum effectiveness.

The effectiveness of herbicides and possible injury to sprayed crops, or to subsequent crops, are influenced by the weather, soil type and other conditions. **Pay close attention to the instructions and warnings printed on the labels of all herbicides.**

Both chemical and product ("trade") names are used in this publication. The use of a trade name does not constitute a guarantee or warranty of the product by the Ontario Weed Committee. Neither does this use signify that these products are approved to the exclusion of comparable products.

For the protection of the public and to minimize adverse effects on the environment, pesticide sales and use are regulated by the Ontario Ministry of the Environment. Many of the herbicides recommended in this publication are available for use by the general public; some may be purchased and used only by licensed spray operators or agriculturists while others may be used only under permit, issued by the Pesticides Control Section, Ontario Ministry of the Environment. Established tolerances for pesticide residues are applicable only in Canada and may not be acceptable in Products for export. For further information on the regulatory aspects of herbicide use, contact the local office of either the Ontario Ministry of Agriculture and Food or the Ontario Ministry of the Environment.

Additional information on chemical and other phases of weed control may be obtained from your Agricultural Representative; Soils and Crops Specialist; Fruit and Vegetable Specialist; Weeds and Seeds Specialist; or from Provincial Agricultural Institutions at Toronto, Guelph, Ridgetown, Kemptville, Simcoe or Vineland Station. (See pages 144 to 146 for addresses and telephone numbers.) Other publications on weed control and related topics are listed on Inside Back Cover.

The herbicides listed in this publication are registered by Agriculture Canada, Ottawa. A herbicide should not be used on any crop unless it has been registered for that crop.

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EMERGENCY PROCEDURE FOR PESTICIDE POISONING

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL, TAKING THE LABELLED PESTICIDE CONTAINER WITH YOU.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water.

If a pesticide has come in contact with the eyes, rinse them with plenty of water for 15 minutes.

The Occupational Health and Safety Division, Ministry of Labour, 400 University Ave., Toronto, M7A 1T7, has physicians available for consultation on first-aid information and advice. They can be contacted in the following manner:

Between the hours of 8:00 a.m. and 5:00 p.m. Monday to Friday, telephone (416) 965-3610.

During weekends, public holidays and non-office hours, telephone (416) 965-1211 and ask for the "on-call" physician.

WEED CONTROL GLOSSARY

(Also see Notes on Chemicals)

ACID (2,4-D, glyphosate) — the active part of the product being used — usually indicated in grams per L on the label.

ACTIVE INGREDIENT — the chemical compound in a product that is responsible for the herbicide effects.

ADJUVANT — an ingredient added to a spray mixture to aid or modify the action of the herbicide, or to alter the physical characteristics of the mixture.

AMINE — type of formulation of a chemical.

BAND TREATMENT — a herbicide applied as a narrow strip over the crop row, usually followed by inter-row cultivation.

COMPATIBLE — compounds or formulations that can be mixed and applied together without undesirably altering their separate effects.

CONTACT CHEMICALS — chemicals which kill only the parts of the plant on which they are sprayed.

DIRECTED TREATMENT — a treatment directed onto the weeds or soil in such a manner as to avoid contact with the crop.

DORMANT — a resting stage similar to the condition of a plant during the winter.

EMERGENCE — the time at which the seedling first appears above the ground.

ESCAPE — a plant in a treated area that has been missed or survived the treatment.

ESTER — type of formulation of a chemical.

FORMULATION — means the same as PRODUCT — an active ingredient processed with other materials to make it usable; or, the type of herbicide commercially available, such as amine, low-volatile ester or sodium salt of 2,4-D.

HERBICIDE — a chemical which is used to kill or inhibit weeds.

HORMONE-TYPE HERBICIDE — includes 2,4-D, 2,4-DB, mecoprop, MCPA, MCPB, dichlorprop, dicamba, TBA, picloram.

LOW-VOLATILE ESTER — a formulation of chemical which, after application, is less likely to damage nearby plants by vapor activity than regular esters.

NONSELECTIVE HERBICIDE — a chemical used in such a manner that all vegetation — both weed and crop — is damaged.

PERENNIAL — a plant that lives for more than 2 years.

PRODUCT — the contents of a herbicide container as marketed. It contains the active ingredient and other solvents, surfactants or carriers that are referred to as inert ingredients.

PROGRAM — application of one or more herbicides at two different stages of crop and/or weed growth. The second herbicide application is used to provide control of the weeds either escaping the original herbicide treatment or which are problems at different periods in the growth of the crop.

RESISTANT — a crop not damaged by a herbicide if applied as recommended, or a weed not controlled by any practical rate of herbicide.

SELECTIVE HERBICIDE — a chemical used in such a manner that it will kill weeds on a growing crop without damaging the crop.

SODIUM SALT — type of formulation of a chemical.

SOIL STERILANT — a nonselective chemical that acts through the soil to prevent the growth of plants.

SURFACTANT — an ingredient in or added to the herbicide formulation to improve the dispersing, spreading, sticking, or wetting properties of the spray mixture.

SUSCEPTIBLE — a crop that may be damaged — or a weed that may be controlled readily by a recommended rate of herbicide.

TANK-MIX — two chemicals that are purchased separately and mixed in the sprayer tank — as opposed to a mixture formulated by the manufacturer (Kil-Mor, Amizine).

TRANSLOCATED HERBICIDE — a chemical (herbicide) that moves within the plant.

TRIAL USE ONLY — this term is used to denote that the treatment has not been tested enough for a general recommendation, but is sufficiently safe and promising to be tried on a limited area and is registered for that use.

THE USE OF CHEMICALS TO CONTROL WEEDS

Chemicals may be used for the control of weeds either **selectively** in crops or **nonselectively** for the control of perennial weeds or on land not in crops, such as roadsides, fencerows and areas difficult to cultivate.

The treatments listed in this publication are based on extensive field trials and observation on farms. **Herbicides should not be used in cold frames or greenhouses unless specifically recommended.**

The grower should not rely on only one chemical or practice over a period of years. For example, 2,4-D controls most broadleaf annual weeds but it does not kill grasses. When the broadleaf weeds have been killed, the weeds not controlled can become a serious problem. The use of ATRAZINE in a continuous corn program may not provide adequate control of late germinating annual grasses. These weeds may be controlled by the use of some other herbicide, or by a change in the method of using the desired herbicide.

Time of Herbicide Treatment in Crop Areas

The susceptibility of both crops and weeds to herbicides is related to the time of application. Therefore, it is important to use the chemical at a time when the crop is at its maximum resistance and the weeds are at their maximum susceptibility. This time will vary depending on the crop involved and the herbicide being used. Different terms of describing the times at which herbicides may be applied have come into general use. Unless specified differently, these times refer to the stage of development of the crop plants.

PREPLANTING TREATMENTS — Preplanting treatments are applied before the crop area is sown or planted. Some herbicides used in this way act on germinating seedlings, others may also kill weed seeds. Most herbicides when used preplanting must be thoroughly incorporated with the soil soon after application. Directions for incorporation are given throughout the publication where these materials are recommended.

PREEMERGENCE TREATMENTS — Chemicals used in preemergence treatments are applied after seeding but before the specified weed or crop emerges. The chemicals may control weeds by (1) killing weed seedlings and/or (2) establishing a toxic layer of chemical on or near the soil surface in which germinating seeds and young seedlings cannot survive.

For successful preemergence treatments the crops must either be tolerant of the chemical at the seedling state or the toxicity must have disappeared before the crop emerges.

A smooth, well-prepared seedbed which is free of clods is necessary for best results. The surface soil should also be moist and the temperature favorable for the rapid germination of weed seeds.

POSTEMERGENCE TREATMENTS — Postemergence treatments are applied after the crop and weeds have emerged. A selective chemical is used and the weeds are killed with little damage to the desirable plants. The types of weeds that may be controlled depend on (1) the susceptibility of the weed, and (2) the tolerance of the crop To the chemical. Treatment at the correct stage of crop development is important. Since most weeds are more susceptible to chemicals when young, early treatments will require less herbicide and will result in less damage to crops from weed competition and from spray equipment.

Sometimes a herbicide may be applied postemergence to the crop but preemergence to the weeds. For example, a crop may be cultivated, then a herbicide applied to the weed-free soil to control subsequent germinating weeds.

Chemical Weed Control in Non-Crop Areas

TREATMENT WITH SOIL STERILANTS — Perennial weeds may be eradicated and the growth of annual weeds prevented by the use of chemicals which temporarily sterilize the soil. These soil sterilants may be applied at any time. Best results are obtained if application is followed by a period of rainfall.

TREATMENT WITH TRANSLOCATED CHEMICALS — In eradicating perennial weeds, heavier dosages of 2,4-D and other translocated chemicals than would normally be used in cropland must be applied. Mixtures of 2,4-D with other chemicals may be used to keep areas free from vegetation.

TREATMENT WITH CONTACT CHEMICALS — These chemicals are not selective but kill all foliage they contact. While this will kill annual weeds, regrowth usually develops from the roots or crowns of perennial plants.

APPLYING HERBICIDES

An exterminator's license may be required by a person applying herbicides on property other than his own domestic property. An operator's license is required by a person operating an extermination business. **For further information**, contact any Ministry of the Environment Regional Office or the Ministry of the Environment Pesticides Control Section, 135 St. Clair Avenue West, Toronto, M4V 1P5.

Successful chemical weed control requires the application of the correct quantity of herbicide uniformly over the area. With selective weed control in field crops, this application becomes a precision operation with reliable equipment.

The chemical is applied as an emulsion, solution, or suspension. The volume of the mixture used per hectare depends on the herbicide and the crop being treated. Generally low volumes 50 to 200 L per hectare are used when 2,4-D chemicals are sprayed on emerged weeds, and higher volumes (150 to 300 L per hectare) when preemergence herbicides are applied.

Small areas may be treated with a garden sprayer, or even with a watering can, if care is taken to wet all foliage. Power equipment is necessary for larger areas. Equipment used for applying 2,4-D-like chemicals should not be used later for applying other solutions to 2,4-D-susceptible crops or garden plants.

The possibility of damage to nearby crops or plants from herbicide drift is increased by the use of high pressure, small nozzle tips, herbicide dusts or mists. Every precaution should be taken to ensure that no drift occurs from the treated areas.

The application of herbicides by mist or air-blast sprayers in agricultural areas of Ontario is NOT recommended.

Application of herbicides by aircraft may be feasible, particularly where large areas of a crop are grown in a solid block. Because of the potential for increased drift when aerial application is practised, it is necessary to use every precaution. Such precautions include spraying at a time of day (early morning or evening) when drift due to wind is more apt to be minimal. It may be wise to prespray areas near susceptible crops or trees with ground equipment, thus leaving the larger open areas for aerial application.

In general, aerial application of hormone-type herbicides such as 2,4-D is NOT recommended in agricultural areas where susceptible crops may be damaged. It is recognized, however, that some hormone-type herbicides are being applied by aircraft in certain areas such as on cereal crops grown where no susceptible crops, trees, gardens, etc., will be affected.

Aerial applicators must be licensed by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the Pesticides Act for the aerial application of Schedule 1 and 5 herbicides and Schedule 2 hormone-type herbicides. The area to be sprayed must be inspected by Ministry personnel to ensure that spraying can be done without injury to susceptible crops.

HERBICIDE DRIFT

Vapor drift is the movement of fine particles from a herbicide that tends to give off vapor at the time of or after application. Vapors will increase as temperature rises. Vaporization reduces the effect of the herbicide application and increases the danger to nearby susceptible crops.

Spray drift is the windborne movement of fine spray particles away from the intended target area. Drift will occur any time that the wind is strong enough to carry the particles. Damage caused by drift will depend on how much herbicide escapes and on the susceptibility of the crop or plants that it reaches. High pressure, small nozzles and wind will increase the danger of drift. Lower pressures, larger nozzles, a larger volume of water and spraying only when wind speeds are low will decrease the danger.

METRIC EQUIVALENTS
1 kilogram per hectare (kg/ha) = 0.89 pounds per acre
1 litre per hectare (L/ha) = 0.7 pints per acre
SEE PAGE 150 FOR OTHER METRIC EQUIVALENTS

TABLE 1. HERBICIDES USED IN ONTARIO

Common, Brand and Trade Names* (See footnote on page 11)	Example of Brand Name Products* or Common or other name of active ingredient	Formulation** (See footnote on page 11)	Guarantee % active unless stated	Conversion Factor (See footnote)
AATREX	atrazine	Su	500 g/L	2.0
		WP	80	1.25
		WP	90	1.1
AATREX-NINE-O	atrazine	SG	90	1.1
AATREX-PLUS	atrazine + oil	Su	400 g/L	2.5
AA SOIL DRENCH	allyl alcohol	Sn	98	1.0
AFOLAN EC	linuron	EC	190 g/L	5.3
AFOLAN F	linuron	Su	450 g/L	2.2
AFESIN	monolinuron	EC	200 g/L	5.0
alachlor	LASSO	EC	480 g/L	2.1
	LASSO 15	Gr	15	6.7
ALANAP	naptalam, NPA	Sn	240 g/L	4.2
allidochlor	CDAA, RANDOX	EC	480 g/L	2.1
		Gr	20	5.0
allyl alcohol	CALSA	Sn	98	1.0
AMIBEN	chloramben	Gr	10	10.0
		Sn	240 g/L	4.2
AMILON	chloramben/linuron	WP	(3 to 1) 50	2.0
amine dinitro	dinoseb	EC	300 g/L	3.3
		EC	360 g/L	2.8
		Sn	300 g/L	3.3
		Sn	360 g/L	2.8
amino triazole	AMIZOL, amitrole	SP	50	2.0
		SP	90	1.1
		Sn	240 g/L	4.2
amino triazole/ ammonium thiocyanate	AMITROL-T, CYTROL	Sn	240 g/L	4.2
		PS	1	
amitrole	amino triazole, AMIZOL	See above		
amitrole/simazine	AMIZINE	Em	(1 to 2) 25.5	3.9
		WP	(1 to 3) 60	1.7
	STERIL LIQUID	Li	(1 to 4) 50 g/L	20.0
AMITROL-T	amino triazole/ ammonium thiocyanate	See above		
AMIZINE	amitrole/simazine	Em	(1 to 2) 25.5	3.9
		WP	(1 to 3) 60	1.7
AMIZOL	amino triazole, amitrole	See above		
ammonium sulfamate	Poison-Ivy & Brush Killer	Sn	500 g/L	2.0
AQUA-KLEEN	2,4-D	Gr	20	5.0
asulam	ASULOX F	Sn	400 g/L	2.5
ASULOX F	asulam	Sn	400 g/L	2.5

HOW TO USE THE CONVERSION FACTOR

Multiply recommendation of amount of active ingredient in text by the conversion factor to get the amount of product to use.

Example **Dry materials** To apply 1.1 kg/ha linuron to control annual weeds in carrots
LOROX WP (50% active) 1.1 x 2 = 2.2 kg/ha (product)

Liquid or flowable To apply 2.25 kg/ha atrazine to control seedling weeds in corn
AATREX (500 g/L active) 2.25 x 2 = 4.50 L/ha (product)

TABLE 1. HERBICIDES USED IN ONTARIO (Cont'd)

Common, Brand and Trade Names* (See footnote on page 11)	Example of Brand Name Products* or Common or other name of active ingredient	Formulation** (See footnote on page 11)	Guarantee % active unless stated	Conversion Factor (See footnote)
ATLACIDE	sodium chlorate	SP	59.2	1.7
atrazine	AATREX	Sn	500 g/L	2.0
	ATRAZINE	WP	90	1.1
	AATREX-NINE-O	SG	90	1.1
	ATRAZINE	WP	80	1.25
	ATRAZINE-FLOWABLE	Su	470 g/L	2.1
	ATRAZINE 50L	Su	500 g/L	2.0
	ATRAZINE 4.8L	Su	480 g/L	2.1
	VECTAL	WP	80	1.25
	VECTAL FLOWABLE	Su	500 g/L	2.0
atrazine + oil	ATRA-MIX, AATREX-PLUS, AATREX-PLUS FLOWABLE	Su	400 g/L	2.5
atrazine/butylate	ATRAZINE/SUTAN	Gr	(1 to 3) 24	4.2
ATRA-MIX	atrazine + oil	Su	400 g/L	2.5
atrazine/simazine	EKKO, ERAMOX	WP	(1 to 1) 80	1.25
AVADEX BW	triallate	EC	400 g/L	2.5
		Gr	10	10.0
AVENGE 200C	difenzoquat	Sn	200 g/L	5.0
BANVEL	dicamba	Sn	400 g/L	2.5
barban	CARBYNE	EC	120 g/L	8.3
		EC	240 g/L	4.2
BASAGRAN	bentazon	Sn	480 g/L	2.1
BASAMID	dazomet	Gr	98	1.02
BASFAPON	dalapon	SP	74	1.35
bensulide	BETASAN, PREFAR, PRE-SAN	EC	480 g/L	2.1
	BETASAN	Gr	12.5	8.0
bentazon	BASAGRAN	Sn	480 g/L	2.1
bentazon/atrazine	LADDOK	Sn	(1 to 1) 400 g/L	2.5
BETASAN	bensulide	EC	480 g/L	2.1
		Gr	12.5	8.0
		Li	348 g/L	2.9
BLADEX	cyanazine	WP	80	1.25
		Su	480 g/L	2.1
BLAGAL	cyanazine/MCPA	Sn	(1 to 2) 375 g/L	2.7
BLAZINE	cyanazine/atrazine	WP	(2 to 1) 80	1.25
		Su	(2 to 1) 480 g/L	2.1
bluestone	copper sulfate	SG		
bromacil	HYVAR X	WP	80	1.25
	HYVAR X-L	Sn	240 g/L	4.2
bromacil/diuron	KROVAR	WP	(1 to 1) 80	1.25
BROMOX 450M	bromoxynil/MCPA	EC	(1 to 1) 450 g/L	2.2
bromoxynil	TORCH	EC	225 g/L	4.4
	PARDNER	EC	225 g/L	4.4
bromoxynil/MCPA	BROMOX 450M	EC	(1 to 1) 450 g/L	2.2
	BUCTRIL M	EC	(1 to 1) 450 g/L	2.2
BUCTRIL M	bromoxynil + MCPA	EC	(1 to 1) 450 g/L	2.2
butylate	SUTAN	Gr	10	10.0
butylate + antidote	SUTAN +	EC	800 g/L	1.25
butylate + atrazine	SUTAN/ATRAZINE	Gr	(3 to 1) 24	4.2
CALSA	allyl alcohol	Sn	98	1.0
CARBYNE	barban	EC	120 g/L	8.3
		EC	240 g/L	4.2
CASORON	dichlobenil	Gr	4	25.0
CDAA	allidochlor, RANDOX	EC	480 g/L	2.1
		Gr	20	5.0
chloramben	AMIBEN	Sn	240 g/L	4.2

TABLE 1. HERBICIDES USED IN ONTARIO (Cont'd)

Common, Brand and Trade Names* (See footnote on page 11)	Example of Brand Name Products* or Common or other name of active ingredient	Formulation** (See footnote on page 11)	Guarantee % active unless stated	Conversion Factor (See footnote)
		Gr	10	10.0
	Ornamental weeder	Gr	4	25.0
	Garden weeder	Gr	1.2	83.0
	NO-HOE	Gr	4	25.0
chloramben/linuron	Amilon	WP	(3 to 1) 50	2.0
chloroxuron	TENORAN	WP	50	2.0
chlorpropham	CIPC	EC	480 g/L	2.1
		Gr	20	5.0
		Gr	10	10.0
chlorthal dimethyl	DACTHAL, DCPA	Gr	2.3	43.5
		Gr	5	20.0
		WP	75	1.33
CIPC	chlorpropham	EC	480 g/L	2.1
		Gr	10	10.0
		Gr	20	5.0
COBUTOX	2,4-DB	EC	400 g/L	2.5
COMPITOX	mecoprop	Sn	150 g/L	6.7
COMPITOX PLUS	mecoprop + 2,4-D	Sn	(1 to 1) 200 g/L	5.0
copper sulfate	bluestone	SG		
CRABGRASS PREVENTER	bensulide	Li	348 g/L	2.9
CUTRINE PLUS	copper compound	Sn	9	11.1
		Gr	3.7	27.0
		Sn	130 g/L	7.7
cyanazine	BLADEX	WP	80	1.25
		Su	480 g/L	2.1
cyanazine/atrazine	BLAZINE	WP	(2 to 1) 80	1.25
		Su	(2 to 1) 480 g/L	2.1
cyanazine/MCPA	BLAGAL	Sn	(1 to 2) 375 g/L	2.7
cycloate	RO-NEET	See RO-NEET		
CYTROL	amino triazole/ ammonium thiocyanate	Sn	240 g/L	4.2
DACTHAL	DCPA, chlorthal dimethyl	Gr	2.3	43.5
		Gr	5	20.0
		WP	75	1.33
dalapon	DOWPON M, BASFAPON, DALAPON	SP	74	1.35
DALAPON Quack Grass Killer	dalapon	SP	25	4.0
dazomet	SOIL KARE (MYLONE)	Gr	50	2.0
dazomet	BASAMID	Gr	98	1.02
DCPA	chlorthal dimethyl, DACTHAL	Gr	2.3	43.5
		Gr	5	20.0
		WP	75	1.33
DESORMONE	2,4-D/dichlorprop	EC	480 g/L	2.1
DESORMONE	2,4-D/dichlorprop	EC	700 g/L	1.4
dicamba	BANVEL,	Sn	400 g/L	2.5
	DYCLEER 24	Sn	600 g/L	1.7
dicamba/MCPA	DyVEL	Sn	420 g/L	2.4
dichlobenil	CASORON	Gr	4	25.0
2,4-D	2,4-dichlorophenoxyacetic acid	EC		
		Sn	Assorted	
		PS		
		Gr		
2,4-D/dicamba	DYCLEER 24	Sn	600 g/L	1.7
2,4-D/dichlorprop	DESORMONE	EC	480 g/L	2.1
	ESTAPROP	EC	600 g/L	1.7
	DIPHENOPROP, ISOPROP,			

TABLE 1. HERBICIDES USED IN ONTARIO (Cont'd)

Common, Brand and Trade Names* (See footnote on page 11)	Example of Brand Name Products* or Common or other name of active ingredient	Formulation** (See footnote on page 11)	Guarantee % active unless stated	Conversion Factor (See footnote)
	PROPATURF, SILVAPROP	EC	700 g/L	1.4
	DESORMONE	EC	700 g/L	1.4
2,4-D/mecoprop	MECOTURF PLUS 2,4-D	Sn	400 g/L	2.5
	COMPITOX PLUS	Sn	(1 to 1) 200 g/L	5.0
	PREMIUM LAWN WEEDKILLER	Sn	(1 To 1) 250 g/L	4.0
2,4-D/mecoprop/ dicamba	KILLEX	Gr, Sn, PS		
	KIL-MOR	Sn	500 g/L	2.0
2,4-DB	EMBUTOX E	EC	400 g/L	2.5
	COBUTOX	EC	400 g/L	2.5
	2,4-D BUTYRIC	EC	400 g/L	2.5
dichlorprop	See above mixtures			
diclofop-methyl	(2,4-D/dichlorprop)			
difenzoquat	HOE-GRASS	EC	190 g/L	5.3
	EC	Sn	200 g/L	5.0
	190 g/L	EC	300 g/L	3.4
	5.3	EC	600 g/L	1.7
		Sn	360 g/L	2.8
		Sn	600 g/L	1.7
dinoseb	DINITRO, AMINE DINITRO, SINOX, DNBP, DOW PREEMERGE 360.	See above		
diphenamid	ENIDE	WP	50	2.0
DIPHENOPROP	2,4-D/dichlorprop	EC	700 g/L	1.4
diquat	REGLONE	Sn	200 g/L	5.0
	REGLONE A	Sn	200 g/L	5.0
diuron	KARMEX	WP	80	1.25
DNBP	dinoseb	See dinitro		
DOWFUME MC 2	methyl bromide + chloropicrin	Li		
DOWPON M	dalapon	SP	74	1.3
DUAL	metolachlor	EC	960 g/L	1.05
DYANAP	naptalam/dinoseb	Sn	(2 to 1) 360 g/L	2.8
DYCLEER	dicamba	Sn	400 g/L	2.5
DYCLEER 24	2,4-D/dicamba	Sn	600 g/L	1.7
DyVEL	dicamba/MCPA	Sn	420 g/L	2.4
EKKO	atrazine/simazine	WP	(1 to 1) 80	1.25
EMBARK	mefluidide	Sn	150 g/L	6.7
EMBUTOX E	2,4-DB	EC	400 g/L	2.5
ENIDE	diphenamid	WP	50	2.0
EPTAM	EPTC	EC	800 g/L	1.25
		Gr	2.3	43.5
		Gr	5	20.0
		Gr	10	10.0
EPTC	EPTAM	See above		
EPTC + antidote	ERADICANE	See below		
ERADICANE	EPTC + antidote	EC	800 g/L	1.25
ERAMOX	atrazine/simazine	WP	(1 to 1) 80	1.25
ESTAPROP	2,4-D/dichlorprop	EC	(1 to 1) 600 g/L	1.7
flamprop-methyl	MATAVEN	EC	150 g/L	6.7
fosamine ammonium	KRENITE	Sn	480 g/L	2.1
GESAGARD	prometryne	WP	80	1.25
glyphosate	ROUNDUP	Sn	356 g/L	2.8
GRAMOXONE	paraquat	Sn	200 g/L	5.0
GRO-TARD	maleic hydrazide	Sn	29	3.5
HERBEC 20 P	tebuthiuron	PE	20	5.0
hexazinone	VELPAR	SP	90	1.1
HOE-GRASS	diclofop-methyl	EC	190 g/L	5.3

TABLE 1. HERBICIDES USED IN ONTARIO (Cont'd)

Common, Brand and Trade Names* (See footnote on page 11)	Example of Brand Name Products* or Common or other name of active ingredient	Formulation** (See footnote on page 11)	Guarantee % active unless stated	Conversion Factor (See footnote)
HYVAR X	bromacil	WP	80	1.25
HYVAR X-L	bromacil	Sn	240 g/L	4.2
ioxynil	TOTRIL	EC	225 g/L	4.4
KARMEX	diuron	WP	80	1.25
KERB	propyzamide	WP	50	2.0
KILLEX	2,4-D/mecoprop/dicamba	Gr, Sn, PS	Assorted	
KIL-MOR	2,4-D/mecoprop/dicamba	Sn	500 g/L	2.0
KRENITE	fosamine ammonium	Sn	480 g/L	2.1
KROVAR	bromacil/diuron	WP	(1 to 1) 80	1.25
LADDOK	bentazon/atrazine	Sn	(1 to 1) 400 g/L	2.5
LASSO	alachlor	EC	480 g/L	2.1
LASSO II	alachlor	Gr	15	6.7
LEXONE	metribuzin	WP	50	2.0
LEXONE DF	metribuzin	SG	75	1.33
LEXONE L	metribuzin	Sn	480 g/L	2.1
linuron	LOROX	WP	50	2.0
LOROX	linuron	WP	50	2.0
LOROX L	linuron	Su	480 g/L	2.1
maleic hydrazide	MH, MH-30, SLO-GRO	Sn	350 g/L	2.9
	GRO-TARD	Sn	29	3.5
MATAVEN	flamprop-methyl	EC	150 g/L	6.7
MCPA	METHOXONE, MCPA-sodium salt,	Sn		
	MCPA amine	Sn	Assorted	
MCPB	TROPOTOX	Sn	400 g/L	2.5
MCPP	mecoprop	Sn	See below	
mecoprop	MCPP, MECOTURF, COMPITOX	Sn	Assorted	
MECOTURF	mecoprop	Sn	150 g/L	6.7
MECOTURF + 2,4-D	mecoprop/2,4-D	Sn	400 g/L	2.5
mefluidide	EMBARK	Sn	150 g/L	6.7
metam-sodium	VAPAM	Sn	380 g/L	2.6
METHOXONE	MCPA	Sn	500 g/L	2.0
methyl bromide	DOWFUME MC2	Li		
metobromuron	PATORAN	WP	50	2.0
	PATORAN FL	Su	400 g/L	2.5
		Su	670 g/L	1.5
metolachlor	DUAL	EC	960 g/L	1.05
metolachlor/ atrazine	PRIMEXTRA	Su	(3 to 2) 500 g/L	2.0
metribuzin	SENCOR, LEXONE	WP	50	2.0
	SENCOR 500	Su	500 g/L	2.0
	LEXONE L	Su	480 g/L	2.1
	LEXONE DF	SG	75	1.33
	SENCOR 75 DF	DF	75	1.33
MH, MH 30	maleic hydrazide	Sn	360 g/L	2.8
monolinuron	AFESIN	EC	200 g/L	5.0
MYLONE	dazomet	Gr	50	2.0
naptalam	ALANAP	Sn	240 g/L	4.2
naptalam/dinitro	DYANAP	Sn	(2 to 1) 360 g/L	2.8
NaTA Grass Killer Pellets	trichloroacetic acid, TCA	SG	85	1.2
NO-HOE	chloramben	Gr	4	25.0
ORNAMENTAL WEEDER	chloramben	Gr	4	25.0
paraquat	GRAMOXONE	Sn	200 g/L	5.0
paraquat/diquat	WEEDRITE, WEED-BAN	Gr	(1 to 1) 5	20.0
paraquat/simazine	TERRAKLENE	Su	(1 to 4) 500 g/L	2.0
PARDNER	bromoxynil	EC	225 g/L	4.4

TABLE 1. HERBICIDES USED IN ONTARIO (Cont'd)

Common, Brand and Trade Names* (See footnote on page 11)	Example of Brand Name Products* or Common or other name of active ingredient	Formulation** (See footnote on page 11)	Guarantee % active unless stated	Conversion Factor (See footnote)
PATORAN	metobromuron	WP	50	2.0
PATORAN FL	metobromuron	Su	400 g/L	2.5
		Su	670 g/L	1.5
pebulate	TILLAM	EC	720 g/L	1.4
picloram	TORDON 10K	PE	10	10.0
picloram/2,4-D	TORDON 101	Sn	(1 to 4) 300 g/L	3.2
Poison-Ivy & Brush Killer	ammonium sulfamate	Sn	500 g/L	2.0
POISON-IVY KILLER	amitrole T	Sn	240 g/L	4.2
PREFAR	bensulide	EC	480 g/L	2.1
PREMERGE 360	dinoseb	Sn	360 g/L	2.8
PREMIUM LAWN WEEDKILLER	2,4-D/mecoprop	Sn	(1 to 1) 250 g/L	4.0
PRE-SAN	bensulide	EC	480 g/L	2.1
PRIMATOL	atrazine	Su	500 g/L	2.0
PRIMATOL	atrazine	WP	80	1.25
PRIMEXTRA	metolachlor/atrazine	Su	(3 to 2) 500 g/L	2.0
PRINCEP	simazine	WP	80	1.25
PRINCEP-NINE-T	simazine	SG	90	1.0
prometone	PROMETONE	EC	240 g/L	4.2
		WP	80	1.25
PROMETONE	prometone	See above		
prometryne	GESAGARD	WP	80	1.25
propyzamide	KERB	WP	50	2.0
propanil/MCPA (LV ester)	STAMPEDE CM	EC	460 g/L	2.2
PROPATURF	2,4-D/dichlorprop	EC	700 g/L	1.4
PYRAMIN FL	pyrazon	Su	500 g/L	2.0
PYRAMIN	pyrazon	WP	80	1.25
		Sn	430 g/L	2.3
pyrazon	PYRAMIN, PYRAMIN FL	See above		
RANDOX	CDAA, allidochlor	EC	480 g/L	2.1
		Gr	20	5.0
REGLONE	diquat	Sn	200 g/L	5.0
REGLONE A	diquat	Sn	200 g/L	5.0
RO-NEET	cycloate	Gr	10	10.0
		Sn	720 g/L	1.4
ROUNDUP	glyphosate	Sn	356 g/L	2.8
SENCOR 500 F	metribuzin	Su	500 g/L	2.0
SENCOR 50 WP	metribuzin	WP	50	2.0
SENCOR 75 DF	metribuzin	DF	75	1.33
siduron	TUPERSAN	WP	50	2.0
SILVAPROP	2,4-D/dichlorprop	EC	700 g/L	1.4
SIMADEX	simazine	Su	500 g/L	2.0
		WP	80	1.25
SIMMAPRIM	simazine	WP	80	1.25
simazine	PRINCEP	WP	80	1.25
	PRINCEP-NINE-T	SG	90	1.1
	SIMMAPRIM	WP	80	1.25
	SIMADEX	Su	500 g/L	2.0
		WP	80	1.25
SINBAR	terbacil	WP	80	1.25
SINOX	dinoseb	Sn	360 g/L	2.8
		Sn	600 g/L	1.7
SLO-GRO	maleic hydrazide	Sn	350 g/L	2.9
sodium chlorate	ATLACIDE	SP	59.2	1.7
SODIUM-TCA	trichloroacetic acid, TCA	Gr	79.3	1.25

TABLE 1. HERBICIDES USED IN ONTARIO (Cont'd)

Common, Brand and Trade Names* (See footnote below)	Example of Brand Name Products* or Common or other name of active ingredient	Formulation** (See footnote below)	Guarantee % active unless stated	Conversion Factor (See footnote)
		SP	84, 85	1.2
		SP	95	1.05
SOIL KARE (MYLONE)	dazomet	Gr	50	2.0
SPIKE 80WP	tebuthiuron	WP	80	1.25
SPIKE 5 G	tebuthiuron	Gr	5	20.0
STAMPEDE CM	propanil/MCPA (LV ester)	EC	(3.6 to 1) 460 g/L	2.2
STERIL LIQUID	amitrole/simazine	Li	(1 to 4) 50 g/L	20.0
SUTAN	butylate	Gr	10	10.0
SUTAN +	butylate + antidote	EC	800 g/L	1.25
TBA-4 General Weed Killer	TBA	Li	400 g/L	2.5
TCA, trichloroacetic acid	NaTA Grass Killer Pellets	SG	85	1.2
TCA	sodium-TCA	SG	79.3	1.25
		SP	84.85	1.2
		SP	95	1.05
trichlorobenzoic acid	TBA	Li	400 g/L	2.5
tebuthiuron	SPIKE 80 WP	WP	80	1.25
	SPIKE 5 G	Gr	5	20.0
	HERBEC 20P	PE	20	5.0
TENORAN	chloroxuron	WP	50	2.0
TERRAKLENE	paraquat/simazine	Su	500 g/L	2.0
terbacil	SINBAR	WP	80	1.25
terbutryn/terbuthylazine	TOPOGARD	WP	50	2.0
TILLAM	PEBC, pebulate	EC	720 g/L	1.4
TOPOGARD	terbutryn/terbuthylazine	WP	50	2.0
TORCH	bromoxynil	EC	225 g/l	4.4
TORDON 10K	picloram	PE	10	10.0
TORDON 101	picloram/2,4-D	Sn	(1 to 4) 300 g/L	3.2
TOTRIL	ioxynil	EC	225 g/L	4.4
TREFLAN	trifluralin	EC	545 g/L	1.8
		Gr	1.47	68.0
triallate	AVADEX BW	EC	400 g/L	2.5
		Gr	10	10.0
trichloroacetic acid	TCA, sodium-TCA	See TCA above		
trifluralin	TREFLAN	See TREFLAN		
TROPOTOX	MCPB	Sn	400 g/L	2.5
TROPOTOX PLUS	MCPA/MCPB	Sn	(1 to 15) 400 g/L	2.5
TUPERSAN	siduron	WP	50	2.0
UREABOR	mixture	Gr	98	1.0
VAPAM	metam-sodium	Sn	380 g/L	2.6
VECTAL	atrazine	WP	80	1.25
VELPAR	hexazinone	SP	90	1.1
VERNAM	vernolate	EC	720 g/L	1.4
vernolate	VERNAM	See above		
VORLEX		Sn	1150 g/L	0.87
		Sn	1200 g/L	0.83
WEED-BAN	paraquat/diquat	Gr	(1 to 1) 5	20.0
WEEDONE GARDEN WEEDER	chloramben	Gr	1.2	83.0
WEED-RITE	paraquat/diquat	Gr	(1 to 1) 5	20.0

*Mention of a Brand or Trade name in this table does not constitute a guarantee or warranty of the product by the Ontario Weed Committee. Neither does this use signify that these products are approved to the exclusion of comparable products. All Trade names are capitalized.

**Symbols used are: DF = dry flowable; EC = emulsifiable concentrate; EM = emulsion; Fl = flowable; Gr = granular; Li = liquid; PE = pellets; PS = pressurized spray; SG = soluble granules; Sn = solution; SP = soluble powder; Su = suspension (flowable); WP = wettable powder.

NOTES ON CHEMICALS

These notes should be considered with the recommendations given later in this publication. Additional information on use, toxicity, and safety precautions is given here.

AFESIN (see MONOLINURON)

AFOLAN (see LINURON)

AGRAL 90 is a non-ionic wetting agent for improved coverage of paraquat and diquat. Use 250 — 1000 mL per L of spray where specified on the paraquat or diquat label.

ALACHLOR (LASSO) is a liquid or granular used on corn, soybeans, dry beans and potatoes. Either formulation can be used as a preemergence treatment for corn or soybeans. The liquid can also be used as a preplant incorporated treatment for corn, soybean and dry beans. The liquid formulation, only, should be used as a postemergence treatment on corn. **ALACHLOR** controls annual grasses and gives only fair control of annual broadleaf weeds. It lasts only 8 to 12 weeks in the soil and requires 0.6 cm of rainfall within 10 days after application to be activated. It is effective over a wide range of soil types and has a good margin of crop safety. Perennial weeds are not controlled.

ALANAP (see NAPTALAM)

ALGIMYCIN PLL-C liquid or granular algicide is used for control of chara, nitella and filamentous green algae in wholly enclosed ponds having no outflow. This product contains copper as the active ingredient in the form of chelates of copper citrate and copper gluconate and is not generally toxic to fish such as trout unless used in very soft water. To minimize hazard of oxygen depletion where algae is dense treat only one portion at a time allowing 10 to 14 days between treatments.

ALLIDOCHLOR (RANDOX), which is effective on muck soils, is used on the onion crop. The liquid formulation can be applied as a preemergent spray at low volumes (150 to 300 L water) or as a postemergent spray at high volumes (900 to 2000 L water). The granular formulation is generally used postemergent to the crop to prevent weed seed germination. Under warm, moist soil conditions the chemical will decompose in from 3 to 6 weeks. Randox is very soluble and, during heavy rains, leaches readily to the onion roots causing crop injury. It is effective over a wide range of soil moisture conditions. The chemical and its vapors cause irritation to the eyes and skin, so precautions should be taken to avoid spilling it on hands or clothing and to avoid inhaling the fumes. Keep containers tightly sealed when not in use and open indoors only when adequate ventilation is provided. The material is not corrosive to spray equipment. A permit may be required for its use.

AMIBEN (see CHLORAMBEN)

AMILON (see CHLORAMBEN + LINURON)

AMITROLE, AMITROLE-T soluble powder or liquid, is active against a wide range of plants. It is particularly useful for the control of quack grass, poison ivy, milkweed, Canada thistle and cattails. The chemical is readily absorbed by both the roots and tops and its action is characterized by a chlorosis, or bleaching, of newly developing shoots. The chemical is also translocated within the plant. Spray operations should emphasize a thorough wetting of actively growing vegetation.

A mixture of amitrole with ammonium thiocyanate is marketed as a liquid called amitrole-T. Control of quack grass is better than with amitrole.

Heavier doses of amitrole T will leave the soil barren for a period of time. A few crops, for example corn, have a degree of tolerance. However, if the area is to be sown, follow manufacturer's directions closely.

AMIZINE (AMITROLE/SIMAZINE) emulsion or wettable powder is used around fruit trees in established orchards for season-long control of broadleaf weeds and grass. This product also is effective as a general weed killer for use on non-cropped land. This combination product can be used effectively for soil sterilization. The herbicidal activity of amitrole destroys the existing vegetation and simazine provides long-term maintenance of the weed-free areas produced. Uniform coverage is important and touch-up operations may be necessary.

AMMONIUM SULFAMATE liquid is used for the eradication of vegetation. This chemical may be used as an overall spray for weeds and small brush, as a stump treatment to prevent resprouting, and for the eradication of poison-ivy and creeping-rooted perennial weeds by preventing all plant growth on the treated area. Ammonium sulfamate is not a fire hazard and is not poisonous to livestock. Spray equipment should be washed thoroughly after use as This chemical is corrosive to metals.

ASULAM (ASULOX F) is a carbamate herbicide formulated as a 400 g/L aqueous solution. It is taken up by both plant leaves and roots, is translocated to other parts of the plant and is active at growing points where it inhibits all cell division. Although death of the growing point occurs in 7 to 10 days, death of the whole plant may require two weeks. The rate of action is increased by high temperatures (25 to 35°C). Registered for the control of wild oats and certain broadleaf weeds, including mustard in flax and seedling alfalfa.

ASULOX F (see ASULAM)

ATRAZINE is actively absorbed both through the root system and foliage and can be used as a preemergence or postemergence treatment for weed control in corn. Corn is tolerant and can be grown in the presence of high rates. Atrazine can persist in the soil for varying lengths of time, depending on the weather and soil conditions (longer under dry, cool weather and sandy soils). Postemergence treatments have tended to persist longer than preemergence treatments. Granular formulations give longer soil residues than liquid or wettable powder formulations. Thorough agitation is required in the spray tank to keep atrazine suspended. (See corn section for methods of reducing atrazine residues in the soil.)

ATRAZINE/BENTAZON (see BENTAZON/ATRAZINE)

ATRAZINE/CYANAZINE (see CYANAZINE/ATRAZINE)

ATRAZINE/METOLACHLOR (see METOLACHLOR/ATRAZINE)

AVADEX BW (see TRIALLATE)

AVENGE (see DIFENZOQUAT)

BANVEL LIQUID HERBICIDE (see DICAMBA)

BARBAN (CARBYNE) — This herbicide (sold as an emulsifiable concentrate) is used as a postemergence spray for the control of wild oats in spring wheat, barley, peas and flax. The label lists specific nozzles to use. Other chemicals should not be mixed with barban as this can reduce the wild oat kill and damage the crop. Usually the ideal times for spraying wild oats and for spraying broadleaf weeds in cereals do not coincide. If, however, it is necessary to apply barban and chemicals like 2,4-D amine on the same day, the barban should be applied first.

Barban can be used on barley seeded down to alfalfa, sweet, red, and alsike clovers, but grasses like brome, orchard and timothy can be injured if emerged at time of spraying. This chemical has a low order of mammalian toxicity, but refer to the label precautions before feeding treated plants to livestock.

BASAGRAN (see BENTAZON)

BASAMID (see DAZOMET)

BENSULIDE (BETASAN, PREFAR) for preemergence control of annual grasses in established lawns and cucumbers. Available as an emulsifiable concentrate, a granular, and in fertilizer mixtures. It will remain active in the soil over winter, so may be applied to turf in the fall for crabgrass or annual bluegrass control the following summer.

BENTAZON (BASAGRAN) is a postemergence herbicide recommended for control of various broadleaf weeds in peas, flax and in all beans and corn. To ensure satisfactory control, the label recommendations for specific broadleaf weeds must be closely followed. Such weed growth stages generally correspond to bean growth stages of 1 to 4 trifoliate leaves. Weed leaf surfaces must be thoroughly covered by the spray. Peas are tolerant after they have 3 pairs of leaves. Beans are generally tolerant at all stages of growth after the first trifoliate leaves are fully developed. Some temporary crop injury may occur when Bentazon is applied during extreme weather conditions.

BENTAZON/ATRAZINE (LADDOCK) is a 1:1 mixture available as a 400 g/L solution for use in all types of ensilage, field, seed and sweet corn. Corn is tolerant to bentazon/atrazine at all stages of growth. It is a postemergence herbicide recommended for control of various broadleaf weeds, including triazine-resistant strains. To ensure satisfactory control, the label recommendations for specific broadleaf weeds must be closely followed. Weed leaf surfaces must be thoroughly covered by the spray. ASSIST oil concentrate should always be added to the spray solution when applying bentazon/atrazine.

BIVERT PH, an emulsifying adjuvant produced from fatty amines and petroleum distillates which, when combined with oil, constitutes the oil phase in a bifluid system to produce water in oil, or oil in water in oil invert emulsions.

BLADEX (see CYANAZINE)

BLAGAL (see CYANAZINE/MCPA)

BLAZINE (see CYANAZINE/ATRAZINE)

BORON COMPOUNDS are relatively persistent in the soil and used as soil sterilants. They are particularly effective against leafy spurge. The action of these chemicals is largely through the roots. Certain species of grasses are somewhat tolerant to boron compounds and often are the first plants to revegetate treated areas. These herbicides are non-toxic and non-corrosive. They may be applied directly or in mixtures with 2,4-D, or a substituted urea herbicide. When mixed with sodium chlorate, the boron reduces the fire hazard associated with the chlorate.

BROMACIL is a substituted uracil available as a wettable powder. Weed destruction is rapid at recommended rates under minimal rainfall. Persistence in the soil is equal to diuron. It is particularly effective when used at 1.1 to 3.3 kg (active) per hectare for annual control of all growth in combination with paraquat, sodium chlorate, or oils. Bromacil should **NOT** be used where it is likely to leach, wash, or move with eroded soil into contact with the roots of desirable trees and shrubs. It can be used to control brush as a spot treatment.

BROMOXYNIL, an emulsifiable concentrate, is absorbed by plant foliage and moves very little within the plant. Wild buckwheat, smartweed, lamb's-quarters, and wild mustard are killed if the chemical thoroughly contacts these plants before they have more than 4 true leaves. Most established perennial broadleaf weeds, chickweed, and grasses tolerate field applications of this herbicide. The formulation includes a wetting agent to improve the spread of droplets on the leaf. Commercial formulations of bromoxynil and MCPA ester (1:1 ratio) are also available. These formulations give better control of mustards than bromoxynil alone. Although bromoxynil is not an effective soil-applied herbicide, broadleaf crops such as turnips, peas and beans should not be seeded for a week after spray application.

BUTYLATE (SUTAN +) emulsifiable concentrate or granular, controls annual grasses in field or sweet corn. It must be applied to a dry soil surface and incorporated into the soil immediately. It forms a gas upon contact with the soil and will be lost if not incorporated. SUTAN + has an antidote added to prevent injury to corn. This antidote does not affect weed control.

BUTYRICS — 2,4-DB, MCPB — These chemicals are 2,4-D-like in nature, but differ from this chemical in their activity towards certain plant species. Thus clovers, peas, and flax will tolerate dosages of these chemicals that will control weeds such as Canada thistle. The formulations of butyrics and their application follow the pattern described under 2,4- D, except the butyrics should be applied in at least 150 L of water per hectare.

The addition of small quantities of MCPA to the butyrics increases their effectiveness on mustards and a number of other annual weeds.

CARBYNE (see BARBAN)

CASORON (see DICHLOBENIL)

CDAA (see ALLIDOCHLOR)

CHLORAMBEN (AMIBEN) is formulated in liquid or granular form. It is used as a preemergence herbicide to control annual grasses and broadleaf weeds in soybeans, white beans, kidney beans, lima beans, snapbeans, tomatoes, peppers, potatoes, seedling asparagus, pumpkins and squash, woody ornamentals and a number of other ornamentals. Satisfactory soil moisture after application is important for its activity. Cocklebur and mustards escape its control. Chloramben has a short residual providing 6 to 8 weeks control after application. Granular chloramben, sometimes used as a lay-by treatment to an established crop such as tomatoes or peppers, should be applied to freshly cultivated or weed-free soil. Do not apply when crop foliage is wet.

CHLORAMBEN plus LINURON (AMILON) — Wettable powder containing 37.5% chloramben and 12.5% linuron by weight to make a 50% WP. AMILON is used as a preemergence treatment to control annual grasses and annual broadleaf weeds in soybeans and potatoes. Rainfall within 7 to 10 days after application is necessary for herbicidal activity, otherwise shallow cultivation is recommended to improve weed control. Use on loam to clay soils, but not on sandy soils for crop injury may result. Soybean forage from treated areas should not be fed to livestock.

CHLORATE WEED KILLERS (see SODIUM CHLORATE)

CHLOROXURON (TENORAN) wettable powder is used on strawberries. It enters weeds principally through the roots and to a lesser extent through the foliage. Chloroxuron is used in single or multiple applications on strawberries at any time after planting until fall, and on bearing plants in the early spring and after picking until fall. Clean cultivation should precede reapplications. Under dry conditions, irrigate before or immediately after treatment. The adherence to label directions is important to obtain good control of broadleaf annual weeds and suppression of germinating annual grasses.

CHLORPROPHAM (CIPC) emulsifiable concentrate or granular, is used as a preemergence spray to control weeds in onions, gladioli and nursery stock. The granular formulations of chlorpropham can be applied to the soil surface as a dry application in emerged onions, spinach, established woody nursery stock, and in emerged gladioli. This chemical controls seedling annual weeds and germinating seeds. It is very effective in the control of purslane.

CHLORTHAL DIMETHYL (DACTHAL) wettable powder or granular, controls crabgrass and other annual grasses and some broadleaf weeds in lawns, onions, strawberries and in some flowers and ornamentals. It is important that it be applied before the weed grass seeds germinate in the spring and therefore, application prior to May 15 on lawns is usually necessary. Fall application is also satisfactory. Control of these grasses may be expected for the remainder of the season. Most turf grasses (with the possible exception of the bents) have good tolerance. Irrigation may be important to ensure activity.

CITOWETT PLUS should be added to bentazon when weeds reach the upper limit in height for effective control or when controlling perennial weeds. The addition of 0.25 L **CITOWETT PLUS** to 100 L spray solution is recommended.

CUTRINE PLUS is an algicide, available as a liquid formulation. It is a chelated copper compound which remains in solution in hard water, unlike copper sulfate. This compound is not registered for use in lake or open water treatments. In ponds, water flow should not be entirely shut off during or following treatment as the subsequent oxygen depletion may be toxic to aquatic organisms. In soft water ponds where fish are present, algicide dosage should be halved and minimal treatment undertaken only where necessary.

CYANAZINE (BLADEX) is a wettable powder or flowable suspension for use in corn. The wettable powder can be used preemergence or postemergence but do not use the flowable formulation postemergence to the crop. It controls annual grasses and broadleaved weeds with a good margin of safety to the crop, and has excellent activity on crabgrass. Severe infestations of barnyard grass, fall panicum or pigweed may not be adequately controlled. The material is only moderatly persistent in the soil and does not present a carry-over hazard. For maximum activity, rainfall is required within 10 days after preemergence application. Quack grass is not controlled. Use the lower rate on sandy soils and the high rate on loams. Not recommended for heavy clay soils such as Brookston clay, or muck.

CYANAZINE/ATRAZINE (2:1) (BLAZINE) is a mixture available as an 80% wettable powder or 480 g/L water dispersible suspension for use in corn. The wettable powder can be used preemergence or postemergence but do not use the dispersible suspension formulation postemergence to the crop. This mixture controls annual grasses and broadleaved weeds with a good margin of safety to the crop. Formulated or tank-mixes will improve control on clay soils and the control of barnyard grass and pigweed. For maximum activity rainfall is required within 10 days after preemergence application. Use the lower rate on sandy soils and the high rate on loams or clay. Do not use the mixture on muck or peat soils.

CYANAZINE/MCPA (BLAGAL) is a flowable suspension of cyanazine and MCPA. It is registered for the control of annual broadleaf weeds in spring wheat, barley, oats and mixed grain. Best weed control will be achieved when the weeds are small and actively growing, after the cotyledon stage and before the 5-leaf stage. **BLAGAL** may cause temporary yellowing of the lower leaves of the crop, particularly if extremely high temperatures or moisture stress occurs around the time of spraying.

CYCLOATE (RO-NEET) emulsifiable concentrate or granular is used as a preplant incorporated treatment on spinach and red beets. Like **EPTC**, it must be applied to a dry soil surface and disked into the soil immediately.

DACTHAL (see CHLORTHAL DIMETHYL)

DALAPON soluble powder is used for control of quack grass, other grasses, and cattails. This chemical is absorbed through the foliage and roots and is carried throughout the plant. Applications on quack grass in spring or fall are followed by plowing or other cultivation after three days. It may also be used for grass control in asparagus, potatoes, raspberries and established orchards. Heavy treatments of dalapon, as required for quack grass control, may render the soil toxic to a number of crops including corn, wheat and soybeans, for about 5 weeks or longer if the soil is cold or dry. If the area is to be sown after treatment, follow manufacturer's directions closely.

DAZOMET (MYLONE, BASAMID) granular, is used to destroy germinating weed seeds, most nematodes and soil fungi, in potting soil, seedbeds, nurseries, liner beds, and greenhouses. After application to the moist soil surface it should be incorporated thoroughly. Sealing the soil by packing with a roller, overhead sprinkler irrigation, or a plastic or canvas cover will increase the effectiveness of the treatment. The area can be seeded in 14 to 21 days and safety can be confirmed using the germination test described on the label.

DICAMBA (BANVEL LIQUID HERBICIDE, DYCLEER) is a member of the group of herbicides known as the benzoic acids. It is particularly useful for the control of field bindweed, triazine-resistant lamb's quarters and pigweed, smartweed, wild buckwheat and Canada thistle in barley, oats, spring wheat, and corn. In mixtures with 2,4-D or 2,4- D + Dichlorprop, it is effective for brush control, especially conifers. Mixtures of 2,4-D with low concentrations of dicamba are useful for the control of many broadleaf weeds in lawns. Airborne spray drift is toxic to sensitive plants in the same manner as 2,4-D, and similar precautions should be followed. At higher rates it can also be toxic to trees and shrubs with roots feeding below the treated area. There is also a possibility of dicamba vapor drift from treated plant foliage during high temperatures (in excess of 25°C). See comments in HERBICIDE DRIFT (pg. 4), and REDUCTION OF HERBICIDAL DRIFT (pg. 124).

DICAMBA/MCPA (DYVEL) a ready-to-use pre-mix containing dicamba DMA and MCPA K salt. It is recommended for use on barley, spring wheat and oats and is particularly useful in the control of most broadleaf weeds. The chemical can be safely applied between the 2- to 5-leaf stage of the crop.

DICHLOBENIL (CASORON) granular, controls germinating annual weeds and quack grass in woody, ornamental and fruit tree plantings. It should be applied preferably in the late fall or in early spring to reduce volatility losses encountered under high temperature and dry soil conditions. Split applications made in the fall and spring have been effective in control of quack grass.

2,4-D — Effectiveness, ease of application, low cost, and safety to the operator make **2,4- D** the most widely used herbicide in Canada today. With proper application, a wide range of annual, biennial, and perennial weeds may be selectively controlled in crops more or less resistant to this chemical (corn, grasses, cereals, strawberries, etc.). It is also effective against many woody plants.

Unfortunately, some crop and garden plants are as susceptible to 2,4-D as many weeds. Thus, only a trace of this herbicide, either in a spray, dust, or vapor, on a crop like tomatoes or tobacco, may do serious damage.

Even crops that can be sprayed safely may be damaged at certain stages of growth, or by overdoses. Recommendations should be carefully followed.

Annual weeds are controlled more readily with **2,4-D** when they are in the seedling stage. Perennials are more susceptible when there is abundant foliage, or at the early flowering stage. All weeds are more easily killed when growing rapidly in moist soil.

When diluted for use **2,4-D** is non-hazardous to man and animals, non-corrosive, and not a fire hazard. Properly applied, it is a safe and efficient herbicide. At recommended dosages, **2,4-D** does not remain longer than a few weeks in warm, moist soil.

Formulations. Ester, low-volatile ester, and amine formulations, are commonly found on the market. The **esters** are the most active forms of 2,4-D and are usually used at lower rates than other types. They are also more effective against hard-to-kill weeds and brush. As esters of 2,4-D are soluble only in oil, commercial formulations include chemicals which permit the emulsification of the oil carrier in water. **Low-volatile ester** formulations reduce the hazard of volatility associated with the regular esters. The **amines**, at recommended rates, are as effective against many weeds and are safer to use on many crops. Amines dissolve readily in water.

Volatility. Since damage to nearby plants may arise from vapors from areas treated with the ester formulations, **only the amines should be used on lawns, around gardens, or in susceptible crop areas**. Low-volatile esters can be used by agriculturists or licensed applicators in areas where risk of damage to sensitive non-target vegetation is low. Volatile esters such as the mixed butyl ester of 2,4-D, are not readily available in Ontario. Users of these volatile esters must obtain a permit from the Ministry of the Environment, 135 St. Clair Avenue West, Toronto, M4V 1P5 (416-965-2401).

Acid Equivalent. Recommendations are on the basis of 2,4-D acid equivalent. Commercial products differ in their content of acid equivalent and this must be considered in determing the amount of product to use.

2,4-D/CHLORATE MIXTURES — Mixtures of 2,4-D amine and chlorates, prepared as recommended, give excellent control of roadside weeds and brush at reasonable cost. Such mixtures are low volatile and are, therefore, somewhat safer to use in areas where crops susceptible to 2,4-D are grown. Either sodium chlorate or the chlorate mixtures may be used.

2,4-DB (see BUTYRICS)

> **CAUTION** — When mixing 2,4-D with other chemicals, bring one of the chemicals to field dilution before adding the other.

DICHLORPROP is the common name for 2,4-D propionic acid. It is more effective in the control of certain weeds such as chickweed, wild buckwheat and smartweed than regular 2,4-D acetic acid. Dichlorprop-2,4-D mixture is available as a low-volatile ester. It is labeled for use on wheat and barley but should not be used for oats. Dichlorprop-2,4-D mixtures are also useful for deciduous brush control and can be combined with either paraquat or dicamba for the control of conifers.

DICLOFOP-METHYL (HOE-GRASS) is a postemergence herbicide for the control of annual grasses and volunteer corn in many crops. Application should be made when the grassy weeds are in the 1- to 4-leaf stage and before tillering. Application of the spray at a 45° angle forward will result in better coverage. Do not apply if rain is expected within one hour after application. Tank mixtures of diclofop-methyl with other herbicides must not be used. Other postemergence herbicides must be applied at least four days after diclofop-methyl application.

DIFENZOQUAT (AVENGE 200 C) is formulated as a liquid and sold for the control of wild oats in barley. The chemical is most effective when applied to actively growing Wild oats in the 3- to 5-leaf stage of development. Do not apply difenzoquat to plants that are wet with dew or rain, or if rain is expected within 6 hours. The herbicide is very soluble in water and rain can wash it off plants before there has been sufficient penetration into the leaves.

The lower leaves of barley can be injured if cool weather conditions are present at time of spraying or within 1 or 2 days after. Frost or temperatures within 1 or 2 degrees of frost will accentuate this injury. This injury is usually temporary and does not reduce barley yield. Consult label directions about suitable tank-mixes with difenzoquat.

DINITRO (see DINOSEB)

DINOSEB (DINITRO) — Emulsifiable concentrate or solution, which may be combined with fuel oil and water, used as a top-killer of herbaceous plants. While this treatment will kill most annual weeds, perennials will usually regrow from their roots. The treatment with these dinitros has been referred to as "chemical mowing." Dinoseb, amines or salts, are used as preemergence herbicides in potatoes. Its action is chiefly a contact effect on seedlings, although there is some residual effect against germinating seeds. Perennial weeds usually recover. Moderate volumes of water are necessary for the uniform application of these materials. Treatments at temperatures over 26°C should be avoided. Dinoseb stains clothing and skin readily and is very poisonous if taken internally. Use low pressure during application.

DIPHENAMID (ENIDE) wettable powder controls weeds in tomatoes, tobacco, peppers, ornamentals and strawberries. Diphenamid residues have caused damage to fall- and spring-seeded grains.

DIQUAT (REGLONE) liquid is absorbed through leaves of plants, gives a rapid kill of the leaves contacted but is quickly inactivated by adsorption onto soil particles. It is useful for the rapid removal of foliage to establish a bare soil area. It is also useful for the desiccation of escaped weeds in a white bean or kidney bean or soybean crop just prior to harvest. Diquat is used to control submerged aquatic weeds and corn spurry in grain crops. Diquat must be used with clean (non-turbid) water as the soil particles in muddy water drastically reduce the effectiveness of the material.

DIURON wettable powder controls a wide range of weed seedlings and may be used selectively in crops that are well established. Diuron is recommended for the control of seedling weeds in asparagus and grapes. At higher rates it is an effective soil sterilant with a good degree of persistence. When applied as a spray, continuous agitation is necessary. (See notes on agitation under "Equipment.") Diuron is not volatile, corrosive, nor is it a fire hazard. It is also low in toxicity to man and livestock. Diuron should **NOT** be used where it is likely to leach or wash into contact with the roots of desirable trees or shrubs.

DUAL (see **METOLACHLOR**)

DYANAP (**NAPTALAM + DINOSEB**)

DYVEL (see **DICAMBA/MCPA**)

EKKO (see **SIMAZINE**)

EMBARK (see **MEFLUIDIDE**)

ENIDE (see **DIPHENAMID**)

EPTAM (see **EPTC**)

EPTC (EPTAM, ERADICANE) is a chemical for preplanting treatments of beans, corn, alfalfa, bird's foot trefoil and potatoes and shows promise on some other crops. The chemical forms a gas after application to kill germinating seeds and young seedlings. When contacting soil moisture the gas form is produced very rapidly. The chemical must, therefore, be applied to a dry soil surface and worked into the soil with a disk. This disking should be done immediately after spraying (within 10 minutes) to prevent excessive loss of the chemical.

The crop may be planted as late as 2 weeks after the application without much loss of weed control. **EPTC** is available as an emulsifiable concentrate and as a granular. It is noncorrosive and possesses a low order of mammalian toxicity. Eradicane is a formulation that has an antidote added to prevent injury to corn and should be used rather than Eptam for corn. This antidote will not protect other crops nor affect weed control.

ERADICANE (see **EPTC**)

FLAMPROP-METHYL (MATAVEN) is an emulsifiable concentrate. It is registered for application as a postemergence treatment for control of wild oats in all varieties of wheat, except Selkirk. Mataven should be applied when the majority of wild oats have reached the 3-leaf stage, but before heads begin to appear. The wheat crop should not be beyond the 6-leaf stage at time of application.

FOSAMINE AMMONIUM (KRENITE) effectively controls a number of woody species including oaks, ash, hickory, maple and alder. Cedar and white spruce are quite tolerant. Pine can be effectively controlled in spring if a surfactant is added. Thorough coverage is essential. Woody plants treated with Krenite die very slowly. The stems may not be completely killed 2 years after treatment.

GESAGARD (see **PROMETRYNE**)

GLYPHOSATE (ROUNDUP) solution, controls non-selectively weeds in: (1) industrial and non-crop areas; (2) cropping systems before emergence of barley, corn, oats, soybeans, potatoes, sugar beets, forages and wheat; (3) grapes as a directed spray; (4) site preparation or as a directed spray in apples and pear, stone fruit orchards, tree plantings and nurseries; and (5) turf-grass renovation or establishment. It can be used as a spot treatment for perennial weed control in corn, soybeans, or cereal crops. It can also be used for controlling perennial weeds in industrial and non-crop areas including cattails in dry ditches. For site preparation before planting grape vines, fruit trees, and nursery stock, it should be applied when the weeds are actively growing and fully emerged. This herbicide is absorbed through the leaves and green stem tissues and translocated to underground roots or rhizomes of perennial weeds. Rain within 6 hours of application may reduce its effectiveness. Tillage should be delayed for 5 days or more after application to allow sufficient movement of the chemical to the underground parts of the perennial weed. (See label for information on growth stages of perennial weeds.)

GRAMOXONE (see **PARAQUAT**)

HEXAZINONE (VELPAR) is a triazine herbicide formulated as a wettable powder to be mixed with water and applied as a non-selective postemergence spray on non-cropland areas. It will effectively control many annual and biennial weeds, woody vines, and is particularly effective for the control of most perennial weeds. Do not apply to dormant or semi-dormant plant material. Do not use near desirable trees or plants or allow their roots to come in contact with this material. The degree of control and duration will vary depending on rainfall, temperature, plant species and rate of application.

HOE-GRASS (see **DICLOFOP-METHYL**)

KERB (see **PROPYZAMINE**)

KRENITE (see **FOSAMINE AMMONIUM**)

LADDOK (see **BENTAZON/ATRAZINE**)

LASSO (see **ALACHLOR**)

LEXONE (see **METRIBUZIN**)

LINURON (LOROX, AFOLAN) wettable powder, emulsifiable concentrate or flowable suspension is absorbed through the leaves and the roots of plants. It kills germinating and emerged annual broadleaf weeds and grasses in corn, soybeans, potatoes, carrots and certain other crops. Mixed in an oil-water emulsion it can be applied as a postemergence directed spray on corn. Adequate moisture is required for satisfactory weed-kill after the preemergence application. This material should not be used when crops are seeded in sandy soils (less than 2% organic matter). Soil residues after the recommended rates usually disappear after 3 to 4 months.

LINURON/CHLORAMBEN (see **CHLORAMBEN/LINURON**)

LOROX (see **LINURON**)

MALEIC HYDRAZIDE (MH) acts by reducing or inhibiting shoot growth. It is used horticulturally for sprout control in potatoes, onions and other root crops, and to control the growth of grass around sidewalks and curbs. It is also used to control the growth of grass and reduce the number of mowings on roadsides, parks and industrial areas, etc.

MCPA is similar to 2,4-D in herbicidal activity and in available formulations. Recommendations for both are based on their acid content. **MCPA** is safer to use on such crops as oats and flax and will give acceptable control on normal weed infestations with practically no depression in yield due to the chemical. Canada thistle, buttercup, and Seedling dock are usually more susceptible to **MCPA** than to 2,4-D.

MCPA/DICAMBA (see **DICAMBA/MCPA**)

MCPB (see **BUTYRICS**)

MCPP (see **PROPIONICS**)

MECOPROP (see **PROPIONICS**)

MEFLUIDIDE (Embark) is a plant growth regulator designed for suppression of grass growth and seedhead formation. It is formulated as a solution and is to be sprayed onto actively growing grass early in the season to reduce or eliminate mowing of roadsides, parks, golf course roughs, and hard-to-mow areas such as hillsides, near fences, cemetery markers, etc. Mowing may be done up to one day before or 3 to 7 days after application to improve the appearance, especially when application is delayed beyond May.

METAM-SODIUM (VAPAM) liquid is applied as a preplanting soil drench or by soil injection to seedbeds, etc., for the control of annual and perennial weeds, certain plant diseases, nematodes, and insects. While the chemical acts by vaporizing in the soil, no gas-proof cover is required unless the soil is very porous. A sprinkler application of water should be used to provide a surface "water seal." Planting may take place 12 to 16 days after the treatment. Do not use in greenhouses or other confined spaces without adequate protection. It is poisonous and irritating to eyes and skin. Precautions must be taken.

METHYL BROMIDE is a liquid under pressure which, when released from the container, forms a gas which is toxic to germinating seeds, nematodes, soil-infesting insects, and such soil-borne fungus diseases as Fusarium wilt, seedling wilts, and root rots. It has been used satisfactorily in tobacco seedbeds and in greenhouse ground beds where steam is not available. Methyl bromide is very poisonous to man and livestock and only an experienced operator should attempt its use. The use of This product is subject to the Pesticides Act and a permit must be obtained from the Ontario Ministry of the Environment each time it is to be used. Mixtures of methyl bromide with other volatile materials are available. Chloropicrin (tear gas) may be added to assist in detection of the gas.

METOBROMURON (PATORAN) wettable powder or flowable suspension enters weeds principally through the roots and to a lesser extent through the foliage. It is a selective herbicide for preemergence weed control in potatoes, lima beans, white beans, and soybeans. It controls a wide range of annual broadleaf weeds and annual grasses and has a medium residual effect.

METOLACHLOR (DUAL) emulsifiable concentrate is used on corn, soybeans, white beans and potatoes. It may be applied either preemergence or preplant incorporated on these crops, except white beans where it must only be used preplant incorporated, otherwise, injury to the crop may occur. When incorporating metolachlor, apply as a broadcast treatment and thoroughly incorporate. Only once-over incorporation is necessary. Immediate incorporation is not required! Metolachlor controls annual grasses and when properly incorporated also provides excellent control of yellow nutsedge. This herbicide lasts 10 to 14 weeks in the soil and requires rain within 10 days to be activated. It is effective over a wide range of soil types, but should not be applied to muck, peat muck, or high organic matter soils. Perennial weeds, other than nutsedge, are not controlled.

METOLACHLOR/ATRAZINE (1.5:1) (PRIMEXTRA) is a mixture formulated as a suspension (flowable) for use as a preplant incorporated or preemergence treatment in corn. Rainfall is required within 8 to 10 days after preemergence application to give good control of annual broadleaf and grass weeds. It is effective over a wide range of soil types and has a good margin of crop safety. Perennial weeds are not controlled.

METRIBUZIN (SENCOR, LEXONE) wettable powder, solution, or soluble granule is used as pre- or early postemergence treatment for the control of a wide range of grass and broadleaf weed species in potatoes, in established asparagus. It is also used as a preemergence or tank-mixed preplant incorporated treatment in soybeans or as a postemergence treatment in transplanted tomatoes. Preemergence applications provide better weed control if moisture, either as rain or a light irrigation, is available shortly after treatment. Do not use on muck or high organic soils. Tomatoes should be well established, and good growing conditions including sunny weather should occur immediately before and at time of application.

MONOLINURON (AFESIN) is a substituted urea available as an emulsifiable concentrate recommended for preemergence control of annual broadleaf weeds and some annual grasses in field beans (kidney, white, yellow eye, snap) lima beans, soybeans and potatoes. This material should not be used in sandy soils with less than 2% organic matter.

MONURON (see **DIURON**)

MYLONE (DAZOMET) granular is used to destroy germinating weed seeds, some nematodes and soil fungi in potting soil, seedbeds, and similar locations. It should be applied evenly over the surface of the prepared moist seedbed. Incorporate by sprinkler irrigation soon after application. Ten to 14 days must elapse before the area is planted. Longer than this may be necessary if the soil is cool.

NALCO-TROL is a polyvinyl polymer which, when added to water sprays, reduces spray drift by increasing the droplet size and by reducing the number of fine spray droplets.

NAPTALAM (ANALAP) is a selective herbicide sold as a solution of an emulsifiable concentrate for use on cucumber, cantaloupe, muskmelon, soybeans, and asparagus. It is not effective on emerged weeds. It is applied to the above crops shortly after planting, or to transplanted or emerged melons and cucumbers as needed. It gives weed control for 3 to 8 weeks. Soil surface should be smooth and free from lumps. The naptalam + dinoseb mixture (**DYANAP**) provides more consistent weed control in dry soil and with better annual grass control than naptalam. The mixture is recommended on cucumbers.

NaTA (see TCA)

NON-HERBICIDAL OIL is described as a light mineral oil under the recommendations for oil-water emulsions for applying atrazine. Specifically the oil is described as having 70 to 105 SUS viscosity with 75% or more unsulfonatable residue. This oil is sold containing a suitable emulsifier for oil-water emulsions.

NORBAK-60 — A water-swellable plastic polymer which is used to particulate herbicide spray solutions and reduce spray drift.

OILS — SELECTIVE, effective for weed control in such vegetables as carrots, parsnips, dill, parsley, and in celery seedbeds. They are applied as recommended, undiluted. They should be used early in crop growth because later applications may flavor the harvested crop.

OILS — NONSELECTIVE, used alone or in combination with pentachlorophenol, or dinitros, as contact herbicides kill leaves, etc., on which they are sprayed.

PARAQUAT (GRAMOXONE) solution is absorbed rapidly through the leaves for chemical mowing on drainage ditch banks, on garden paths, and around the base of trees. The chemical is translocated to some extent within both grass and broadleaf weeds but is quickly inactivated by adsorption onto soil particles. Plants must be well covered with the spray for a good "burn off." If the paraquat solution is mixed weaker than 2.5 L of product per 1000 L water, AGRAL 90 should be added at 250 mL/1000 L of spray. Paraquat works best under conditions of low light intensity and high humidity. For best results apply on a dull day or in the evening. This chemical may be fatal if swallowed. Prevent skin or eye contact by wearing rubber gloves and eye goggles or eyeshield when handling. Do not use paraquat in mist blowers or air-blast sprayers. Avoid working in spray mist. Prevent all contact with the skin and eyes. Avoid contact with spray solution. Do not use undiluted. Follow precautions on the label.

PARAQUAT-DIQUAT MIXTURE (WEEDRITE, WEED-BAN) — A granular for homeowner use as a "chemical mower" to control weeds on driveways, pathways, and other non- cultivated areas. It is applied in water with a watering can, dribble bar, or low pressure sprayer to wet the leaves of both grass and broadleaf weeds. Avoid contact with leaves and green bark of desirable shrubs and other garden plants. For best results apply on a dull day, or in the evening, as it is more effective under conditions of low light intensity and high humidity.

PARAQUAT/SIMAZINE (TERRAKLENE) — Liquid suspension for use in apple and pear orchards, in vineyards and in raspberry, loganberry, highbush blueberries and asparagus plantings, and under woody ornamentals. Better results follow its use on a dull or cloudy day or in the evening. This mixture is designed to give rapid kill of emerged weeds through contact action and residual control of germinating weeds.

PATORAN (see **METOBROMURON**)

PEBULATE (TILLAM) (PEBC) emulsifiable concentrate, similar in action to **EPTC** (Eptam), is used as a preplant-incorporated application on red beets, tomatoes and tobacco. Like EPTC, it must be applied to a dry soil surface and disked into the soil immediately. Its main use is for annual grasses and nutsedge control or suppression.

PICLORAM (TORDON) is available for use in Ontario by special permit from the Ontario Ministry of the Environment. It is not recommended in Ontario for use by the general public. Although relatively non-toxic to animals, it has been shown to be highly active toward many plant species, particularly woody plants and most broadleaf weeds and crops. It is because of this high activity, and the probability of damage to desirable plants if it is used incorrectly, that a permit for its use is required.

Picloram may persist in the soil for a number of years. Therefore, it must NOT be applied on land used, or that which may be used for the production of agricultural crops. It must NOT be applied over or near areas where roots of desirable trees or other plants may extend into the soil, or where the chemical may be washed or otherwise moved into contact with roots.

PRIMEXTRA (see **METOLACHLOR/ATRAZINE**)

PRINCEP (see **SIMAZINE**)

PROMETONE is a substituted triazine with relatively long persistence in the soil and little crop selectivity. It is used for vegetation control on non-crop land. Available as an emulsifiable concentrate, prometone can be absorbed by weeds through roots and foliage. For the best results application should be made early in the season before growth is well developed! Prometone is non-corrosive and low in mammalian toxicity. Prometone should not be used in situations where it could leach, wash or erode with treated soil into contact with desirable plants.

PROMETRYNE (GESAGARD) wettable powder is a substituted triazine absorbed by weeds through the root system and through foliage. It can be applied preemergence or on small weeds. Adequate moisture is required for satisfactory weed kill after preemergence application. Prometryne should be thoroughly agitated to keep it in suspension in the spray tank. It is low in mammalian toxicity and is non-corrosive. Persistence in the soil is much less than that of atrazine or simazine.

PROPYZAMIDE (KERB) is a wettable powder which may be used to control quack grass, bluegrass, orchard grass, and other perennial grasses. Common chickweed is also controlled but it will not control dandelions, thistle, bindweed, and most deep-rooted perennial weeds. Quack grass, and other perennial grasses, can be suppressed at lower rates and controlled at higher rates in established alfalfa and bird's-foot trefoil. Kerb should be applied in September to November with best results when soil temperatures are low and sufficient time is allowed before ground freeze for penetration into the soil. The herbicide is absorbed through the roots, and it is therefore most effectively applied when the soil moisture supply is high, and rain or an overhead sprinkler irrigation follows application. Wait 9 months before planting other crops in Kerb-treated soil.

PROPANIL + MCPA (STAMPEDE CM) is an emulsifiable concentrate used for the control of green and yellow foxtail, and certain broadleaf weeds including wild buckwheat, lady's-thumb, and pale smartweed in spring wheat, barley and oats. This herbicide may cause crop yellowing or tip burn but these effects are temporary and normally disappear in 10 to 14 days. Consult the label for information about compatibility with other herbicides, insecticides and fertilizers.

PROPIONICS — These are a series of chemicals similar to the 2,4-D and MCP "acetic" acids. Examples are mecoprop and dichlorprop. The formulations, such as salts and esters, and the uses of these chemicals, are similar to those described earlier under 2,4- D.

The propionics are particularly effective against chickweeds, clovers, and a number of other lawn weeds. Mixtures of propionics with 2,4-D allow The ready control of most of the weeds found in lawns.

PYRAZON (PYRAMIN) is available as a wettable powder or flowable formulation and is used for pre- and postemergence control of annual broadleaf weeds in sugar beets and red beets. For combined grass control it can be mixed with TCA for preemergence use. Rain or irrigation after the treatment is needed to obtain good weed control. If rainfall is uncertain pyrazon can be applied, without TCA, in an oil-water emulsion on emerged beets and weeds.

RANDOX (see **ALLIDOCHLOR**)

REGLONE (see **DIQUAT**)

RO-NEET (see **CYCLOATE**)

ROUNDUP (see **GLYPHOSATE**)

SENCOR (see **METRIBUZIN**)

SIDURON (TUPERSAN) is a selective preemergence crabgrass herbicide for use on established turf, with the exception of Washington Bent. It is available as a wettable powder and in mixtures with fertilizers. It has shown promise for use on new grass plantings also, as it apparently is not toxic to most species of turf grasses. It does not control broadleaf weeds, annual bluegrass or clover.

SIMADEX (see **SIMAZINE**)

SIMAZINE wettable powder or suspension is used for weed control in corn, alfalfa, trefoil, asparagus, apples, pears, grapes, raspberries, gladioli, woody nursery stock, and in non-crop areas. It is relatively insoluble in water and persists for long periods in the soil. Extreme caution is needed if simazine is used in a rotation where susceptible crops may be grown one year after application. If mixed with atrazine for use in corn (**EKKO**), then corn should follow the next year. Susceptible crops include many vegetable crops, beets, peas, beans, cereals, and forage seedlings. Simazine is more persistent than atrazine in the soil. (See note on atrazine and simazine residues in the corn section.) Certain formulations are registered for aquatic plant and algae control.

SINBAR (see **TERBACIL**)

SODIUM CHLORATE is a nonselective herbicide. At low rates it acts as a chemical mower to burn off all foliage, but grasses will regrow in a few weeks. At higher rates, the soil will be sterile for one or more years. The use areas are locations where dead vegetation and soil sterility do not cause problems, or locations where these results are acceptable or desirable.

Sodium chlorate is very **corrosive** to metals. Little harm is done to wire fences, but it is wise to direct the spray away from ornamental fences. All equipment should be thoroughly washed after use.

> **The use of sodium chlorate may constitute a serious fire hazard, as well as potential source of livestock poisoning. Permits may be required from the Ontario Ministry of the Environment under the Pesticides Act, 1973 for the use of herbicides containing sodium chlorate. Inquiries or permit applications should be made to the Ministry of the Environment field offices. See page 143.**

Poisonous Properties. Chlorate weed-killers are poisonous to livestock when taken in relatively large amounts. Do not use as a soil sterilant in pastures where livestock are likely to have access to the treated areas within three months. Keep animals well supplied with salt.

Fire Hazard. Sodium chlorate, and particularly mixtures of sodium chlorate with organic matter, constitute a serious fire hazard when dry.

1. **Use mixtures of sodium chlorate and chemicals with fire-retardant properties.**
2. Never open containers of sodium chlorate in a building.
3. Never allow clothing moistened with chlorate to dry on the body. The slightest friction may cause a serious blaze. Wear rubber boots and wash both boots and clothing after using.
4. Treated areas are highly inflammable. Avoid driving equipment or walking through such areas after a rain.
5. Mix sodium chlorate with other chemicals only in water.
6. When working with sodium chlorate herbicides do not smoke until away from treated area and Your clothes have been changed.
7. Store sodium chlorate in a shed away from other buildings.

SODIUM TCA (see **TCA**)

SPIKE (see **TEBUTHIURON**)

STAMPEDE (see **PROPANIL** + **MCPA**)

SUTAN (see **BUTYLATE**)

TBA — Trichlorobenzoic acid is a nonselective liquid herbicide for the control of certain deep-rooted perennials such as leafy spurge, field bindweed, Canada thistle and evergreens. It is absorbed through both foliage and roots. Residue in the soil may injure soy or white beans for several years. Grasses will be first to recover. Spray drift and possibly vapors may injure 2,4-D susceptible crops nearby. Check label carefully before using on cropland.

TCA (SODIUM TCA, NaTA) is effective for postemergence control of foxtail in barley and oats, for preemergence control of foxtail in sugar beets and red beets and for control of evergreen brush in non-cropped areas. In oats and barley only, TCA can be tank-mixed with 2,4-D amine and MCPA amine for added broadleaf weed control. The chemical may irritate the skin and eyes and will cause burns on prolonged contact.

TEBUTHIURON (SPIKE) is a nonselective soil-active, substituted urea herbicide. Some weeds such as horsetail may not be controlled. Since Spike is nonselective, it should not be applied to soil areas penetrated by roots of desirable plants, or to areas where the chemical could move by washing with heavy rains or eroded soil into contact with desirable plants.

TENORAN (see CHLOROXURON)

TERBACIL (SINBAR) wettable powder is used under established apple and peach trees to control most annual weeds and grasses and provide partial to complete control of perennial weeds such as quack grass, horsenettle and yellow nutsedge. Moisture is necessary to activate this chemical. Do not use on sandy or low organic matter soils (less than 1%), nor on eroded soil areas. Terbacil is also recommended for late fall application to strawberry plants at rates considerably lower than those used under apple or peach trees. A late fall application in strawberry plantings controls many germinating or small broadleaf weeds and grasses until the end of harvest the following year. Quack grass will be suppressed or controlled but not established dandelions. Strawberry plants are sensitive to terbacil so the manufacturer's precautions should be followed carefully.

TERBUTRYN + TERBUTHYLAZINE (TOPOGARD) — wettable powder is used preemergence or postemergence in the potato crop to control seedling annual broadleaf weeds and grasses. It is not effective on established perennial weeds such as quack grass. The chemical is absorbed by the plant through both roots and leaves. It is less effective on grasses than on broadleaf weed species. Do not use on sandy soils low in organic matter.

TERRAKLENE (see PARAQUAT/SIMAZINE)

TILLAM (see PEBULATE)

TOPOGARD (see TERBUTRYN + TERBUTHYLAZINE)

TORDON (see PICLORAM)

TREFLAN (see TRIFLURALIN)

TRIALLATE (AVADEX BW), a liquid or granular herbicide suggested as a preemergence incorporated spray for the control of wild oats in spring wheat and barley and preplant incorporated in barley flax, rapeseed? sugarbeets and dry peas. For preemergence treatment of the cereals, the spray is applied to the soil after the crop is seeded and then thoroughly worked into the soil by harrowing twice, the second harrowing at right angles to the first. The crop should be seeded uniformly, deep enough so it is not disturbed by the harrow. For preplanting treatments in dry peas, the chemical is sprayed on the soil surface and worked into the top 5 to 8 cm of soil with a disk or cultivator implement. The crop can be seeded any time after treatment. In all treatments, the chemical should be worked into the soil within two hours after spraying.

TRIFLURALIN (TREFLAN) emulsifiable concentrate or granular is used as a preplant incorporated treatment on a large number of vegetable crops, soybeans, field beans, field peas, tomatoes and ornamentals. Trifluralin is most effective on annual grasses, but will control most of the common annual broadleaf weeds except ragweed, mustards, annual nightshades, and velvetleaf.

Trifluralin is slightly volatile, is gradually degraded in sunlight, and for maximum herbicidal action it should be incorporated into the soil immediately after spraying. The incorporation implement should be operating at a depth of 7 to 10 cm and used so that it breaks up large clods and mixes the soil thoroughly and uniformly.

TROPOTOX (see BUTYRICS, MCPB)

TROPOTOX PLUS (see BUTYRICS, MCPB/MCPA)

TUPERSAN (see SIDURON)

VAPAM (see METAM-SODIUM)

VELPAR (see HEXAZINONE)

VERNAM (see VERNOLATE)

VERNOLATE (VERNAM) is a herbicide similar in action to EPTC (Eptam). It can be used preplant incorporated or as a preemergence incorporated treatment on soybeans. Like EPTC, it must be applied to a dry soil surface and incorporated immediately into the soil. Vernam is available as an emulsifiable concentrate.

VORLEX — Liquid soil fumigant used for sterilization of plant propagation beds, nursery soils, turf areas, and as a preplant greenhouse and field treatment. It is injected into the prepared soil with special applicators and the soil is sealed immediately by rolling or packing. A number of soil-borne diseases, nematodes, weed seeds, and some insect pests can be controlled.

METRIC EQUIVALENTS
1 kilogram per hectare (kg/ha) = 0.89 pounds per acre
1 litre per hectare (L/ha) = 0.7 pints per acre
SEE PAGE 150 FOR OTHER METRIC EQUIVALENTS

EQUIPMENT

(Further information can be found in Agriculture Canada Publication 1482, Field Sprayers.)

SPRAYERS FOR HOME USE — A 9 to 14 L knapsack or compressed air garden sprayer is satisfactory for use on lawns and around the home. A nozzle tip which produces a fairly coarse spray will help reduce spray drift. Care should be taken to keep the pressure relatively low since pressures of up to 700 kPa can easily be obtained. High pressures produce more very small spray droplets which can drift on light winds to susceptible garden plants. The sprayer should be reserved for use with herbicides and should **NOT** be used to apply insecticides or fungicides.

FIELD SPRAYERS — A trail-behind or mounted sprayer with a power-take-off driven pump and a 6 to 18 m boom is satisfactory for most herbicide spraying. The main requirements for field spraying are: (1) a uniform pressure of between 140 to 480 kPa, (2) a uniform forward speed and (3) an application rate between 55 and 450 L per hectare.

Sprayers equipped with broadcast type of nozzle or nozzles cover a wide swath. They are especially convenient for farm lane and fencerow spraying where a uniform spray pattern is not essential. The spray pattern may be seriously affected by wind and severe drifting may occur even in a light breeze. Never use a broadcast type of nozzle to spray near a susceptible crop.

Most commercially built sprayers can be safely used to apply liquid fertilizers. These materials are more corrosive than herbicides, therefore the sprayers should be drained and thoroughly cleaned if spraying is discontinued for two hours or more. (See section on page 24, "Cleaning the Sprayer".)

AIR-BLAST or **MIST SPRAYERS** — The machines should **never** be used to apply herbicides, especially hormone-type herbicides such as 2,4-D. The danger of causing herbicidal damage at a great distance from the treated area is very great.

AERIAL APPLICATION of herbicides may be used where large acreages of a crop are grown in a solid block and non-susceptible crops are nearby. Application of hormone-type herbicides (see glossary) by aircraft is NOT recommended in areas of intensive agriculture where susceptible crops may be damaged.

Aerial applicators must be licenced by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the authority of the Pesticides Act 1973 for the application of Schedule 1 and 5 herbicides and Schedule 2 hormone-type herbicides. The area will be inspected by Ministry personnel to ensure safety of application.

It is an offense under the Federal Pest Control Product Act to use a control product under unsafe conditions. Precautionary practices must be taken at all times to prevent drift.

ROADSIDE SPRAYERS — Large capacity, truck-mounted sprayers are used for roadside spraying. For general roadside use, the pump should be capable of producing from 200 to 350 kPa. However, for penetration of tangled brush higher pressures may be necessary.

CARE AND USE OF EQUIPMENT

SPRAYING SPEEDS — Since the application rate of herbicides must be uniform, it is imperative that the forward speed of a sprayer be **constant** whenever liquid is being delivered by the nozzles. If the driving wheels of a tractor slip on the soil surface, the tractor's speedometer does not indicate a change in forward speed. To be certain that the forward speed is constant in spite of wheel slippage on hills, use an independent speedometer equipped with a ground-driven wheel. Satisfactory independent speedometers are available from automotive supply stores and farm equipment dealers.

WATER — Use only clean water that has all debris, sand and mud removed from it. Never allow the intake screen to rest on the bottom of a farm pond while filling a sprayer. The intake line, near the screen, should be equipped with a check valve to prevent contamination of the pond or stream when the pump is shut off. The use of a tank- refilling nozzle, volume booster nozzle or injection pump to aid in refilling the sprayer tank from farm ponds or streams should be avoided. These tank-refilling aids may cause pond or stream contamination.

AGITATION — When chemicals in solution are used (2,4-D, etc.) at least 2 to 14 L per minute should be returned to the tank for agitation within the tank. The return or bypass line from the pressure regulator should deliver the liquid to the bottom (**not** the top) of the tank to be effective.

When wettable powders (atrazine, etc.) are used, the return to the tank should be 14 to 27 L per minute for each 450 L of tank capacity, depending on the concentration of the wettable powder and the size of the tank. A special line from the pressure side of the pump (**not** the pressure regulator) to the tank must be used to carry the 14 to 27 L per minute necessary for hydraulic agitation in the tank. This flow can be reduced if the sprayer has a mechanical agitator.

Bilge pumps, designed to pump water out of small boats, can be used to agitate the herbicide in the sprayer tank. These bilge pumps consist of a small centrifugal pump driven by a 6- or 12-volt (DC) electric motor. If the motor is sealed, the entire pump can be submerged in the tank. These pumps have sufficient capacity and durability to provide adequate agitation for chemicals in suspension. Bilge pumps are available from marine supply stores and sprayer dealers.

To prepare a tank mix of a wettable powder and an oil or emulsifiable concentrate, proceed as follows:

1. Fill the sprayer tank to the half-full mark.
2. Start the agitator and pour in the premixed slurry of wettable powder.
3. Agitate for 2 to 3 minutes before adding more water.
4. Add the oil or emulsifiable concentrate last.

Avoid excessive agitation or the mixture may turn into a grease-like mass which will settle to the bottom of the tank or excessive foaming may occur.

To prevent a buildup of oil in the sprayer the tank should be emptied completely before refilling. After any break in the spraying operation agitate thoroughly before proceeding. Clean the tank and sprayer immediately after use with a detergent or solvent and flush with clean water.

PUMPS — Sprayers should be calibrated at least once each year because pump wear reduces pump output. If wettable powders are used, it may be necessary to calibrate the sprayer after only 20 hectares have been sprayed. Piston (plunger), diaphragm, centifugal and some gear pumps are sufficiently durable to handle wettable suspensions.

CAUTION: Never allow a sprayer pump to run without water, even for a short time.

NOZZLE TIPS — Brass flat-pattern nozzle tips are satisfactory for spraying chemicals in solution. However, wettable powders are abrasive and enlarge the opening. The table below is a guide based on studies of the rate of wear of nozzle types. **Sprayers should be calibrated frequently**. Nozzle tips are expendable items and should be replaced when they deliver 10% more than they did when new. Worn nozzle tips provide uneven distribution which produces streaks across the field through delivering too much or too little herbicide.

Relative Durability of Materials
Used in Flat-pattern 13 Nozzle Booms

Material	Durability compared with brass	Maximum area before replacing nozzles
Brass	1	12 hectares
Plastic	3	35
Stainless Steel	19	600
Hardened Stainless Steel	77	more than 600

Flat-pattern nozzle tips are the best for boom-type sprayers used for applying herbicides. Other tips can be useful for special application. **Flooding fan** nozzle tips are used at low pressures and, because of their wide spray angle, can be used closer to the ground surface, thus reducing the drift hazard. The distribution of herbicidal materials may not be as uniform with flooding fan nozzle tips as with the flat-pattern tips. Flooding fan nozzle tips are available in brass, plastic and stainless steel. Half as many of these nozzle tips are required to cover the same width as would be required with flat-pattern nozzle tips. Sprayers equipped with a **broadcast type** of nozzle or nozzles cover a wide swath. They are especially convenient for farm lane and fencerow spraying where a uniform spray pattern is not essential. The spray pattern is affected by wind and severe drifting may occur with even a light breeze. Never use a broadcast type of nozzle to spray near a susceptible crop.

Full or hollow cone nozzle tips may be used for applying herbicides to the soil surface when the herbicide is incorporated or mixed into the soil with a disk harrow, cultivator or similar tillage implement. Special **even-spray nozzle tips** are available for band applications of herbicides. The width of the sprayed band is controlled by the height and spray angle of the nozzle tips as well as its orientation to the direction of travel. Manufacturer's literature and directions should be followed explicitly.

NOTE — When using any nozzle for spraying wettable powders, it is essential to calibrate the sprayer frequently because as a nozzle wears, The quantity of spray material delivered **increases** and distribution is not even.

CLEANING THE SPRAYER — Pump at least 225 L of clean water through the sprayer at the end of the day or when changing from one herbicide to another. Clean the nozzle tips and all screens at the same time. This will help reduce the gummy deposits or the wettable powder accumulations in the sprayer. Wash the sprayer immediately after each use.

Equipment that has applied 2,4-D, MCPA, or related herbicides should **not** be used to spray fungicides or other materials on susceptible crops, and should **not** be parked or stored near greenhouses or other areas where susceptible crops are grown. If the sprayer has a good tank and connecting hoses, and has been used to apply only the amine or sodium salt formulations of 2,4-D, etc. (not the ester), it may be used fairly safely on resistant crops following a thorough cleaning of tank, hoses, boom, nozzles, etc., with strong (preferably hot) solution of a detergent or alkaline cleaner, followed by a thorough rinsing with clean water. See Agriculture Canada Publication 1482, Field Sprayers.

The wash water contains herbicide. Never allow the wash water to run into a farm pond, stream, or other source of clean water.

SPRAYER CALIBRATION

(Determining application rate in litres per hectare)

There are many ways of determining the number of litres of spray material that are being applied to one hectare of land — or calibrating a sprayer. Here is a method that is straightforward and the resulting calculation is relatively simple:

1. Set out two stakes 200 metres apart in the field. Do not use a different distance: to do so will give the wrong value to use in the calculation. The factor is obtained by dividing the number of square metres in a hectare by the distance travelled.

$$\frac{10,000}{200} = 50$$

2. Pick a level spot and fill the sprayer tank with clean water.

Adjust the boom height to give the amount of overlap recommended by the sprayer manufacturer for the nozzle tips and nozzle spacing used. For example, for a spray angle of 65 degrees the boom should be 53 to 58 cm above the surface to be sprayed, for 80 degrees the height should be 42 to 48 cm. Operate the sprayer and adjust the bypass pressure relief valve to give the desired pressure while the nozzles are operating. This will also ensure that the supply line up to the shutoff valve is full. Fill the tank and **record the water level on a measuring stick.**

3. Spray between the stakes in one direction at a **definite speed and pressure**. Turn the boom on as the first stake is passed and turn the boom off as the second stake is passed. **Mark the throttle setting.**

4. Return the sprayer to the same location as before the calibration run. Carefully measure the amount of water

required To refill the tank to the same mark on the measuring stick.

5. Calculate application rate in litres per hectare using this formula:

$$L/ha = \frac{\text{litres of water added} \times 50}{\text{boom length in metres}}$$

Sample calculations:

Overall Spraying: If the sprayer has a 9 m boom and 61 L of water are required to refill the tank, the application rate is:

$$L/ha = \frac{61 \times 50}{9} = 338.9\ L$$

Band Spraying: If the sprayer has 10 nozzles and each nozzle covers a 36 cm band, the total width of the spray patterns (boom length) is:

10 x 36 = 360 cm

or 3.6 m

If 10 litres of water are required to refill the tank, the application rate is:

$$L/ha = \frac{10 \times 50}{3.6} = 139\ \text{litres/hectare}$$

Sprayer calibration bottles are available to recheck the sprayer calibration. For further information contact your local office of the Ontario Ministry of Agriculture and Food.

When band spraying, the acreage actually sprayed is NOT the same as the crop acreage. The herbicide rates given in this publication are based on the area actually sprayed.

DETERMINING THE AMOUNT OF HERBICIDES NEEDED

Most rates suggested in this publication are given in terms of both active (generic name)* and product (TRADE NAME)*. However, where the amount of active ingredient in the formulations available varies considerably, for example, 2,4-D is available in concentrations of 100 g/L, 400 g/L, 500 g/L etc., the rate is given in terms of active ingredient. To convert any rate given in terms of active, consult Table 1 for the factor to use and the example of how to calculate the amount of product to use. Where the rate suggested is given as product, simply use that amount. Check the label on the container before use as all labels must show the amount of active ingredient.

If 2,4-D-like herbicides are involved, a check of Table 8 will show whether the recommended rates will control a particular weed. Specific measures are required to handle weeds that do not respond to the routine program. These are outlined under the crop in question, in special sections, or in Table 6.

Once the chemical is selected and rate of application determined, the question is one of correct application. When a recommendation is given in "acid," or "active," adjustment must be made for the "non-active" portion of the product. Generally the "acid equivalent" in "grams per L," or in "percentage," will be found on the label of the container. Where recommendations are in terms of "product," no adjustment needs to be made. Again, valuable assistance in converting recommendations to field quantities may be found on the label.

Two simple formulas allow the conversion of recommendations in acid equivalent (or active) to amount of product to use. If the information on the product label indicates the number of grams per litre (g/L), multiply the recommended rate by the conversion factor in Table 1 to get litres product per hectare.

If the active ingredient on the product label is in percentage, then multiply the recommended rate by the conversion factor in Table 1 to get kilograms per hectare of product.

Sample calculations (Table 1).

***Throughout the Recommendations sections of this publication,** the generic name of each herbicide (its active material) is printed in lowercase letters (examples: atrazine, dicamba, glyphosate), whereas the product name (the total liquid, or powder, etc., inside the container as supplied by the manufacturer) is printed in capital letters (examples: AATREX, BANVEL, ROUNDUP), and its formulation is listed within brackets following the trade name.

After determining how much commercial product is needed per hectare, and calibrating the sprayer, divide the total number of litres held by the sprayer tank by the sprayer output per hectare to determine the number of hectares each tank will cover. Then add the appropriate quantity of herbicide needed for that number of hectares to the tank and complete filling the tank with clean water.

MATERIALS, MIXING and MIXTURES

Dry, herbicidal powders may be either **soluble** and dissolve in water, or **wettable** which do not dissolve but form a suspension which requires constant agitation.

Liquid spray materials either mix in water to form a solution or may be oil-based and form an emulsion which will require agitation. Emulsions have a milky appearance.

When mixing herbicides that will be applied in one operation, it is safer to first mix one with the quantity of water to be used before the second is added. This procedure reduces the possibility of the formation of gums or precipitates which may clog nozzles and filters. Even so, it must be recognized that certain formulations may react when mixed together, resulting in materials with different properties and activities than the original ones. To avoid this possibility, consult the package labels for information on compatibility and test the proposed mixture in small quantities before using in the sprayer tank. Where water is known to have an excessive salt content, compatibility of the water and the chemical at field strength should be tested first on a small scale — also, see section on agitation in a sprayer, pages 21 and 22.

Commercial formulations of mixtures should be used wherever possible to avoid the possibility of clogged sprayers, poor control, or damaged crops.

Mixtures of different herbicides or mixtures of herbicides with other pesticides or foliar fertilizers should NOT be applied to crops in a single application unless registered for use in this way.

Unless specifically mentioned in this publication, or on a herbicide label, the addition of a surfactant or a detergent to a spray solution by the applicator is NOT recommended.

GRANULAR HERBICIDES

Many herbicides used for preemergence treatments are available as granular formulations. In nearly every case, the performance of the granular formulations is equivalent to that of the liquid. Satisfactory distribution may be obtained with the equipment available.

EVALUATING RESULTS

Do not be hasty in appraising results. Though some herbicides show effects in a few hours, others, such as 2,4-D, may show little effect on the weeds for periods up to two weeks.

Unless cultivation is a part of the recommended treatment, avoid stirring up the soil after spraying because it is likely to encourage the germination of buried weed seeds.

DISPOSAL OF EMPTY HERBICIDE CONTAINERS

Carefully empty **all** contents from the container.

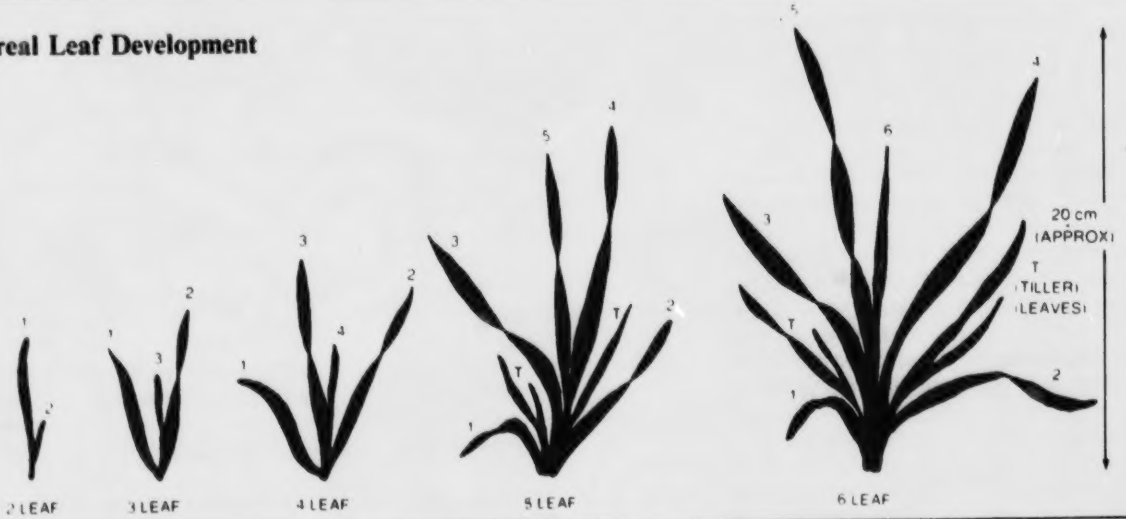
Thoroughly **rinse** the container with water and add this rinse solution to the spray tank. (This includes packages with plastic liners.)

Disposal of containers — puncture or break the container and bury in such a manner that it is covered by at least 50 cm of earth and is not near any water-course or water table or, if the container is constructed of paper or cardboard, by burning, provided that persons and animals are kept out of the smoke and precautions are taken so that the smoke is not directed toward buildings, highways, roads, or outdoor areas frequented by the public.

Keep Herbicides
in Original Containers
and
READ THE LABEL

FIELD CROPS

Stages of Cereal Leaf Development



SPRING WHEAT, OATS and BARLEY NOT UNDERSEEDED to FORAGE CROPS

Weeds must be emerged from the soil surface and in early stages of growth to be killed by the rates of most of the herbicides used on cereal grains. Weeds which are growing during early periods of cereal growth (up to the 5-leaf stage) have the greatest effect on the cereal yield.

Although cereals are quite resistant to chemicals like 2,4-D, they are most resistant in the 5- to 6-leaf stage of their growth. When counting the leaves on cereal plants, some confusion can occur if tiller leaves are present. These leaves are not counted. The above diagram may be useful when determining the cereal leaf stages referred to in the publication.

Crop rotation is a valuable technique used to prevent the buildup of weed populations associated with small grain production. Wild oats can increase in population and severely limit production on fields where small grains are grown continuously. Some weeds i.e., proso millet will be well controlled by cereal competition.

Cereal grains have an advantage in that they do not make use of the full growing season. This is particularly true of the winter cereals where preplanting cultivation and postharvest cultivation can be used to stimulate germination of weed seeds and reduce perennial weed populations.

SPRING WHEAT, OATS AND BARLEY NOT UNDERSEEDED TO FORAGE CROPS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Broadleaf weeds such as mustards, lamb's-quarters, ragweed, pigweed	2,4-D 2,4-D (500 g/L)	0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	Apply when the crop is in the 3- to 5-leaf stage of growth. Do not use on Mingo barley. On oats, do not apply more than 0.50 kg/ha (active) or 1 L/ha (500 g/L) product.
Broadleaf weeds such as hempnettle mustards, lamb's-quarters, ragweed, pigweed	MCPA MCPA (500 g/L)	0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	Apply when the crop is in the 2- to 5-leaf stage of growth.
Many broadleaf weeds including mustards, lady's-thumb, field bindweed, Canada thistle and perennial sow-thistle	dicamba/2,4-D/mecoprop KIL-MOR (500 g/L)	0.42-0.55 kg/ha 0.85-1.1 L/ha	For barley, use only the lower rate and apply when the crop is in the 2- to 3-leaf stage. For wheat and oats apply when the crop is in the 3- to 4-leaf stage. The higher rate is required for control of Canada thistle and Field bindweed.
Many broadleaf weeds including lady's-thumb, field bindweed, Canada thistle, and perennial sow-thistle	dicamba + 2,4-D or MCPA BANVEL (400 g/L) + 2,4-D or MCPA (500 g/L)	100-140 g/ha + 0.28-0.42 kg/ha 0.28-0.35 L/ha + 0.56-0.84 L/ha	The 2,4-D or MCPA should be included if mustards are present. Use only the lower rates on barley and apply when the crop is in the 2- to 3-leaf stage. Use when oats or wheat are in the 2- to 5-leaf stage. Do not use dicamba + 2,4-D on oats.
	dicamba/MCPA (1:4) DYVEL (420 g/L)	0.1/0.4 kg/ha 1.25 L/ha	Apply when cereals are in the 2- to 5-leaf stage. Hempnettle, corn spurry and cow cockle are controlled best when application is made early in this stage.
Many broadleaf weeds including wild buckwheat	dichlorprop/2,4-D (1:1) ESTAPROP (600 g/L)	1.1 kg/ha 1.75 L/ha	For spring wheat and barley only. Apply to emerged weeds when the cereals are in the 3- to 4-leaf stage.
Lady's-thumb, wild buckwheat and many other broadleaf weeds	bromoxynil PARDNER (225 g/L) TORCH (225 g/L)	0.28 to 0.34 kg/ha 1.25 to 1.5 L/ha 1.25 to 1.5 L/ha	Use the lower rate if weeds are not past the 4-leaf stage. Thorough spray coverage of weed foliage is required for control. Application should be made before the cereals have more than 5 leaves because spray coverage will probably not be adequate beyond this stage.
	bromoxynil/MCPA (1:1) BUCTRIL M (450 g/L) BROMOX 450 M (450 g/L)	0.56 kg/ha 1.25 L/ha 1.25 L/ha	Apply before the weeds have more than 5 leaves and the cereals are in the 2- to 5-leaf stage because spray coverage will probably not be adequate beyond this stage.

Many broadleaf weeds including lady's-thumb, wild buckwheat, hempnettle and corn spurry	cyanazine/MCPA (1:2) BLAGAL (375 g/L)	0.84 kg/ha 2.25 L/ha	Use when weeds are in the 2- to 4-leaf stage and the crop is in the 2- to 5-leaf stage. May cause temporary yellowing of the lower leaves of the crop plants.
	linuron + MCPA (amine) LOROX (50 WP) + MCPA (amine) (500 g/L)	0.21 to 0.28 kg/ha + 0.42 to 0.56 kg/ha 0.42 to 0.55 kg/ha + 0.85 to 1.1 L/ha	Apply when weeds are in the 1- to 4-leaf stage and cereals are in the 2- to 4-leaf stage. May cause temporary yellowing of the lower leaves of the crop plants.
Many broadleaf weeds, Canada thistle and perennial sow-thistle	2,4-DB 2,4-DB (400 g/L)	1.1 to 1.4 kg/ha 2.75 to 3.50 L/ha	Apply 2,4-DB at the 5-leaf to early flag stage of cereals.
	MCPB/MCPA (15:1) TROPOTOX PLUS	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply MCPB/MCPA from the 2-leaf stage to flag leaf stage of cereals.
Many broadleaf weeds including wild buckwheat, lady's-thumb, green and yellow foxtail	propanil/MCPA (3.6:1) STAMPEDE CM (460 g/L)	1.28 kg/ha 2.75 L/ha	Apply when the cereals are in the 2- to 5- leaf stage and weeds are in the 1- to 4-leaf stage. Propanil/MCPA may cause crop yellowing or leaf tip burn but these effects normally disappear in 10 to 14 days.
Emerged annual grasses including wild oats in spring wheat and barley	diclofop-methyl HOE-GRASS (190 g/L)	0.7 kg/ha 3.7 L/ha	Apply before the crop reaches the 5-leaf stage when the grasses are in the 1- to 4-leaf stage. Apply not later than 20 days after crop emergence. If herbicides are required for broadleaf weed control, they should be applied at least 4 days after the application of diclofop- methyl.
Wild oats in spring barley and spring wheat	barban CARBYNE (240 g/L)	0.28 to 0.42 kg/ha 1.2 to 1.8 L/ha	Barban will not kill wild oats which have only 1 leaf or more than 2 leaves at time of application. Do not mix with other herbicides. Consult the label for instructions about specific nozzles to use, and other precautions.
	triallate AVADEX BW (400 g/L)	1.4 to 1.7 kg/ha 3.5 to 4.25 L/ha	For wheat, triallate must be applied after planting and worked into the soil to kill wild oats. For barley, triallate can be applied before or after planting and must be worked into the soil. Consult the label for specific instructions on how to work the herbicide into the soil. Use the higher rate on heavier soils.
Wild oats in spring barley	difenzoquat AVENGE 200C (200 g/L)	0.7 to 0.85 kg/ha 3.5 to 4.25 L/ha	Use the lower rate of difenzoquat if the wild oat stand is less than 100 plants per m^2. Apply when the wild oats are in the 3- to 5-leaf stage. Do not use when the plants are wet or if rain is expected within 6 hours. Consult the label about suitable tank mixes with difenzoquat.

SPRING WHEAT, OATS AND BARLEY NOT UNDERSEEDED TO FORAGE CROPS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Wild oats in spring wheat	flamprop-methyl MATAVEN (150 g/L)	0.52 kg/ha 3.48 L/ha	Apply when the wild oats are in the 3- to 5-leaf stage, before the wheat has more than 6 leaves. Do not use on Selkirk.
Emerged quack grass, milkweed and Canada thistle	amino triazole/ ammonium thiocyanate CYTROL (240 g/L) AMITROL-T (240 g/L)	3.25 to 6.75 kg/ha 13.6 to 28.4 L/ha 13.6 to 28.4 L/ha	Apply after harvest to emerged actively growing weeds. Wait 10 to 14 days after spraying before working the area.
Emerged green foxtail in spring- seeded oats and barley	sodium TCA Na TA Grass Killer Pellets (85 SG)	1.1 to 2.3 kg/ha 1.32 to 2.75 kg/ha	Use only the low rate on barley. Apply when the foxtail is in the 1- to 3-leaf stage and the crop is in the 2- to 4-leaf stage. Do not use on cereals seeded less than 7.5 cm deep. May be mixed with MCPA or 2,4-D amine for control of broadleaf weeds.
Emerged quack grass	dalapon DOWPON M (74SP) BASFAPON (74SP)	12.5 kg/ha 16.3 kg/ha 16.3 kg/ha	Apply to actively growing quack grass foliage in the fall. Wait at least 3 days before working the area.
Emerged quack grass	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.75 to 7.0 L/ha	Apply before seeding the crop or after harvest when the quack grass is actively growing with at least 4 new leaves on each emerged shoot. Wait at least 5 days after application before working the area.
Spot treatments on emerged milkweed, field bindweed, Canada thistle and common tansy	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Apply when field bindweed has reached full bloom, Canada thistle, milkweed and common tansy are in the bud to full bloom stage. Emerged cereals will be killed by this treatment. To eliminate the possibility of residues in the crop, apply before the cereals have started to show heads.
After harvest treatment to regrowth of Canada thistle, field bindweed and other perennial broadleaf weeds	glyphosate ROUNDUP (356 g/L) or	3.25 kg/ha 9.1 L/ha	Apply to actively growing weed foliage. Wait at least 5 days after application before working the area.
	dicamba BANVEL (400 g/L) or	1.2 kg/ha 3.0 L/ha	Apply to actively growing weed foliage at least 2 weeks before a killing frost. Wait at least 3 weeks after application before working the area. Plant only cereals, soybeans or field corn in the year after application.
	2,4-D/mecoprop/ dicamba KIL-MOR (500 g/L)	0.55 to 0.86 kg/ha 1.1 to 1.75 L/ha	Apply to actively growing weed foliage. Wait at least 5 days after application before working the area.

TABLE 2. HERBICIDE SELECTION FOR SPECIFIC WEEDS IN SPRING CEREALS NOT UNDERSEEDED

Herbicides *Most reliable treatments	Annual Broad Leaves								Annual Grasses					Perennials		
	corn spurry	lady's-thumb	lamb's-quarters	mustards	pigweeds	ragweed	buckwheat, wild	hempnettle	barnyard grass	foxtail, green	foxtail, yellow	old witch grass	wild oats	bindweed, field	sow-thistle	thistle; Canada
SPRING OATS, WHEAT AND BARLEY																
2,4-D amine			*	*	*	*										
MCPA			*	*	*	*		*								
dicamba (BANVEL)		*	*		*	*	*							*	*	*
dicamba/2,4-D/mecoprop (KIL-MOR)		*	*	*	*	*	*							*	*	*
dicamba/MCPA (DYVEL)	*	*	*	*	*	*	*	*						*	*	*
bromoxynil (PARDNER, TORCH)		*	*		*	*	*									
bromoxynil/MCPA (1:1) (BUCTRIL M, BROMOX 450 M)		*	*	*	*	*	*									
cyanazine/MCPA (BLAGAL)	*	*	*	*	*	*	*	*								
linuron + MCPA (LOROX + MCPA)	*	*	*	*	*	*	*									
2,4-DB			*	*	*	*	*								*	*
MCPB/MCPA (15:1) (TROPOTOX PLUS)			*	*	*	*		*						*	*	*
propanil/MCPA (STAMPEDE CM)		*	*	*	*	*	*			*	*					
SPRING OATS AND BARLEY																
TCA (NaTA Grass Killer Pellets)										*						
SPRING WHEAT AND BARLEY																
dichlorprop/2,4-D (ESTAPROP)			*	*	*	*	*									
barban (CARBYNE)													*			
triallate (AVADEX BW)													*			
difenzoquat (AVENGE 200 C)													*			
diclofop-methyl (HOE-GRASS)									*	*	*		*			
SPRING WHEAT																
flamprop-methyl (MATAVEN)													*			

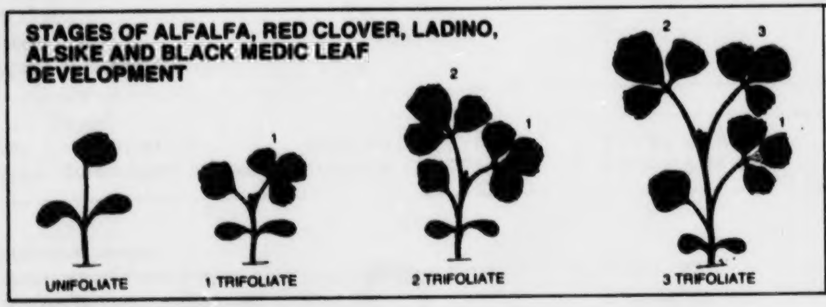
WINTER WHEAT and FALL RYE

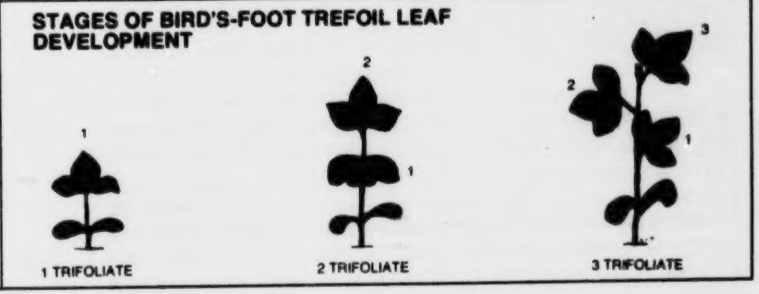
WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Many broadleaf annual and winter annual weeds including pepper-grass, shepherd's purse and stinkweed (pennycress).	2,4-D amine 2,4-D (500 g/L) or MCPA amine or sodium MCPA (500 g/L)	0.35 to 0.55 kg/ha 0.7 to 1.1 L/ha or 0.35 to 0.85 kg/ha 0.7 to 1.7 L/ha	Treat in the spring when the crop growth begins until the early shotblade stage. For control of winter annuals apply early before flower buds appear on the weeds.
Many broadleaf annual and winter annual weeds, Canada thistle and perennial sow-thistle in winter wheat.	dicamba BANVEL (400 g/L)	0.11 to 0.14 kg/ha 0.28 to 0.35 L/ha	Apply in the spring when the crop is 15 to 25 cm tall. Can be used with 2,4-D or MCPA amine 0.42 kg/ha (.84 L/ha of 500 g/L formulations)[1]. The addition of 2,4-D or MCPA will give improved control of pepper-grass, shepherd's purse and pennycress. Do not use on fall rye.
Many broadleaf annual and winter annual weeds in wheat and rye underseeded to red, alsike, white and ladino clovers.	MCPB/MCPA (15:1) TROPOTOX PLUS	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply in the spring when the cereal crop is in the 2-leaf to flag leaf stage, and the weeds are small and actively growing. Legumes should be in the 1- to 3-trifoliate stage. Use 150 to 200 L/ha of spray volume.
Many broadleaf annual and winter annual weeds.	dichloroprop/2,4-D (1:1) ESTAPROP (600 g/L)	1.1 kg/ha 1.75 L/ha	Apply in early spring to emerged weeds. May be used until cereals are up to the flag leaf stage.

SPRING WHEAT, OATS and BARLEY UNDERSEEDED to FORAGE CROPS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Many broadleaf weeds in cereals seeded down to alfalfa, bird's-foot trefoil, red alsike or ladino clovers and grasses.	2,4-DB (2,4-DB 400 g/L)	1.1 to 1.4 kg/ha 2.75 to 3.5 L/ha	Apply in 150 to 200 L water per hectare when the legumes are in the 1- to 3-trifoliate stage. Wild mustard plants are not usually controlled if sprayed when they are beyond the 4-leaf stage. Red clover may be damaged by 2,4-DB.
	2,4-DB + MCPA EMBUTOX E (400 g/L) + MCPA (500 g/L)	0.8 kg + 35 g/ha 2 L/ha + 0.07 L (70 mL)/ha	The addition of MCPA gives better control of common mustard than 2,4-DB alone. Apply in 150 to 200 L water per hectare. Apply when the legumes are in the 1- to 3-leaf stage.

Many broadleaf weeds in cereals seeded down to red; alsike and ladino or white dutch clovers and grasses.	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply in 150 to 200 L water per hectare when legumes are in the 1- to 3-trifoliate leaf stage.
Many emerged broadleaf weeds in cereals seeded to grasses only.	2,4-D 2,4-D (500 g/L) or MCPA MCPA (500 g/L)	0.28 to 0.42 kg/ha 0.56 to 0.84 L/ha 0.28 to 0.56 kg/ha 0.56 to 1.12 L/ha	Apply when the forage grasses have at least 2 leaves and cereals are in the 2- to 5-leaf stage.
Emerged annual grasses in wheat, barley underseeded to alfalfa, red or sweet clover.	diclofop-methyl HOE-GRASS (190 g/L)	0.7 kg/ha 3.7 L/ha	Apply when the annual grass weeds are in the 1- to 4-leaf stage before the cereal reaches the 5-leaf stage. Apply not later than 20 days after emergence of the crop. Do not use if rain is expected within 1 hour after application. Apply herbicides for broadleaf weed control at least four days after diclofop-methyl.
Emerged quack grass.	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.75 to 7.0 L/ha	Apply before the crop is planted when the quack grass has at least 4 new leaves on each emerged shoot. Wait at least 5 days after application before working the area. Apply at least 6 hours before rain.
Emerged milkweed, field bindweed, Canada thistle and common tansy.	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Apply when field bindweed has reached full bloom, and other weeds are in the bud to full bloom stage. Emerged crop plants will be killed by this treatment. Do not apply after the cereals have started to show heads. Do not harvest forage from the treated areas until the treated plants have turned brown. Apply at least 6 hours before rain.


STAGES OF ALFALFA, RED CLOVER, LADINO, ALSIKE AND BLACK MEDIC LEAF DEVELOPMENT


STAGES OF BIRD'S-FOOT TREFOIL LEAF DEVELOPMENT

FORAGE LEGUMES (DIRECT SEEDED)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Nutsedge and many germinating grass and broadleaf weeds.	EPTC EPTAM (800 g/L)	3.4 kg/ha 4.25 L/ha	Before seeding pure stands of alfalfa or bird's-foot trefoil apply to a dry soil surface and incorporate into the soil immediately. Some broadleaf weeds such as ragweed, mustards, and pigweed frequently escape.
Many germinating grasses and broadleaf weeds.	trifluralin TREFLAN (545 g/L)	0.6 to 0.8 kg/ha 1.1 to 1.5 L/ha	Before seeding pure stands of alfalfa incorporate trifluralin into the soil. Established perennials, ragweed and mustards will not be controlled. See page 00 for incorporation method.
Many emerged broadleaf weeds.	2,4-DB 2,4-DB (400 g/L)	1.1 to 1.4 kg/ha 2.75 to 3.5 L/ha	Apply in 150 to 200 L water per hectare, when alfalfa, bird's-foot trefoil or clovers are in the 1- to 3-leaf stage. 2,4-DB usually suppresses legume growth for a period of 2 to 3 weeks. Under drought, high temperature or other stress conditions, 2,4-DB may severely injure legumes.
	2,4-DB + MCPA EMBUTOX E (400 g/L) + MCPA (500 g/L)	0.8 kg/ha + 35 g/ha 2 L/ha + 0.07 L (70 mL)/ha	The addition of MCPA gives better control of common mustard than 2,4-DB alone. Apply in 150 to 200 L water per hectare. Apply when the legumes are in the 1- to 3-leaf stage.
Many emerged broadleaf weeds in clovers (except sweet clover) and grasses.	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply in 150 to 200 L water per hectare when legumes are in the 1- to 3-leaf stage. Clovers may be suppressed for a period of 2 to 3 weeks.
Emerged green and yellow foxtail, barnyard grass, wild oats, old witch grass and volunteer corn.	diclofop-methyl HOE-GRASS (190 g/L)	0.7 kg/ha 3.7 L/ha	Use on alfalfa, red or sweet clover when the grass weeds are in the 1- to 4-leaf stage. Do not apply if rain is expected within 1 hour after treatment. Broadleaf control herbicides must be applied at least 4 days after diclofop- methyl. Do not feed forages in the year of seeding after treatment with diclofop-methyl.
Many annual grasses.	dalapon DOWPON M (74SP) BASFAPON (74SP)	3.25 kg/ha 4.2 kg/ha 4.2 kg/ha	Use on pure stands of alfalfa or bird's-foot trefoil where the treated foliage is not fed to meat or dairy animals in the same crop year after application. Can be mixed with 2,4-DB and used at the same stage of legume growth.
Many annual grasses and broadleaf weeds including mustards.	2,4-DB + asulam EMBUTOX E (400 g/L) + ASULOX F + (400 g/L)	0.6 + 1.1 kg/ha 1.50 L/ha + 2.75 L/ha	Apply when alfalfa is in the 1- to 3-leaf stage.

Emerged quack grass.	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.75 to 7.0 L/ha	Apply before the crop is planted when the quack grass has at least 4 new leaves on each emerged shoot. Wait at least 5 days after application before working the area. Apply at least 6 hours before rain.

ESTABLISHED FORAGE LEGUMES

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Canada thistle and chickory.	2,4-DB 2,4-DB (400 g/L)	1.4 to 1.7 kg/ha 3.5 to 4.25 L/ha	For pure stands or mixtures containing alfalfa or bird's-foot trefoil apply as spot treatment or on regrowth after cutting or grazing. Apply in 150 to 200 L water per hectare.
	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.7 kg/ha 4.25 L/ha	For pure stands or mixtures containing red and alsike clovers. Apply as spot treatment or regrowth after cutting or grazing. Apply in 150 to 200 L water per hectare.
Yellow rocket and winter weeds in red clover, alfalfa and bird's-foot trefoil.	2,4-DB 2,4-DB (400 g/L)	1.4 kg/ha 3.5 L/ha	Apply on actively growing weeds after cutting or grazing in September or October.
To prevent establishment of many weeds in established alfalfa and bird's- foot trefoil.	simazine* PRINCEP (80WP) SIMADEX (500 g/L)	1.1 kg/ha 1.3 kg/ha 2.2 L/ha	Do not use SIMADEX on alfalfa. Apply in September to November before freeze up. This treatment will also prevent legume seedlings from establishing for approximately 8 months. Do not use in the fall before seeding another crop. Do not apply paraquat within 1 year after simazine application. Do not apply to the same field for more than 3 consecutive years. Allow 30 days between applications and grazing cattle or sheep.
	terbacil SINBAR (80WP)	0.56 to 1.2 kg/ha 0.7 to 1.5 kg/ha	For use on alfalfa establishment at least 1 year. Apply after alfalfa is dormant in the fall or before new growth starts in the spring. Use the higher rate on clay or clay loam soils and the lower rate on sands or loams. Do not seed treated area to any crop within 2 years after the last terbacil treatment.
Suppression of grasses, red and alsike clovers in bird's-foot trefoil and alfalfa fields.	dalapon DOWPON M (74SP) BASFAPON (74SP)	3.25 kg/ha 4.2 kg/ha 4.2 kg/ha	Apply in the fall when growth is about 15 cm high. This treatment may reduce the forage yield of some alfalfa varieties in the year after application. Do not feed or graze foliage treated with dalapon to meat or dairy animals during the crop year of application.

ESTABLISHED FORAGE LEGUMES (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Control or suppression of grasses and annual weeds in bird's-foot trefoil and alfalfa fields.	paraquat GRAMOXONE (200 g/L)	0.56 to 1.1 kg/ha 2.8 to 5.5 L/ha	Apply to trefoil seed fields when the crop is 8-15 cm high in the spring. Apply to alfalfa or trefoil forage fields within 5 days after cutting. Slow recovery and some stand reduction has been observed under conditions of drought or high temperatures. Do not use in the spring after treatment with simazine.
Control of quack grass and many other grasses in alfalfa and bird's-foot trefoil.	propyzamide KERB (50WP)	1.1 to 1.63 kg/ha 2.25 to 3.25 kg/ha	Apply in late September to early November before the soil freezes. Do not apply dalapon in the same fall as propyzamide.
Emerged milkweed, field bindweed, Canada thistle and common tansy.	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Apply as spot treatment when the field bindweed has reached full bloom and other weeds are in the bud to full bloom stage. Do not graze or harvest forage from treated spots until the treated plants turn brown.

* SIMADEX (80 WP) equivalent rate is 1.3 kg/ha.

PASTURES (Mostly Grasses)

Overgrazing tends to thin the grass stand and allows the establishment of weeds. Under grazing allows weeds like wild carrot to form and spread seed. Timely mowing can prevent the ripening of weed seeds and reduce the distance these seeds spread with the wind.

Chemicals are available to control most of the troublesome weeds in grass pastures and these can give faster kill of established weeds than any other management practice. A chemical may have to be applied more than once to kill established perennial weeds and the new crop of weeds emerges through a thin grass stand. A poor grass stand can be improved by using a combination of chemicals, fertility and grazing management.

Chemical weed control should extend into fencerows and other areas around the pasture to keep these areas from becoming sources of weed seeds.

Generally, clovers are severely damaged by chemical treatments. However, white clover and black medick show some resistance or reestablish quickly.

Consult the label in regard to the period of time to keep livestock out of the treated area. With most of the chemicals this will be a period of about 5 days, but with AMITROLE or AMITROLE-T it is 6 to 8 months. After glyphosate application wait until the treated plants turn brown before starting to graze the area.

Care should be taken to prevent grazing where poisonous plants (water hemlock, chokecherry, etc.) may be made more attractive to livestock after the chemical treatment. It is a good practice to prevent grazing on the field for at least a week after spraying to reduce the chances of the livestock picking up harmful plants.

Apply chemical treatments in at least 200 L of water per hectare and increase this rate if it is necessary to contact weeds through a thick volume of vegetation.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Blueweed	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply as low-volatile ester as late spring or early fall application.
Brush	See pages 131 to 134		
Burdock	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply as low-volatile ester in fall or spring. This treatment will be most effective on first year rosettes.
Buttercup	MCPA MCPA (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in June and again in early September.
Canada thistle Field bindweed	dicamba BANVEL (400 g/L)	1.2 kg/ha 3.0 L/ha	Apply in late spring when the thistles are in the bud stage and the bindweed is flowering.
	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.7 kg/ha 4.25 L/ha	This treatment has some safety on forage legumes. Use 150 to 200 L water per hectare.
	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.7 to 12.0 L/ha	Apply as spot treatment when the thistles are in the bud to fall bloom stage, and the bindweed is flowering.

PASTURES (Mostly Grasses) (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Chickory	2,4-D (LV ester) 2,4-D (500 g/L)	0.84 kg/ha 1.7 L/ha	Apply in late spring.
Common tansy	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7.0 to 12.0 L/ha	Apply as a spot treatment when the tansy is in the bud to full bloom stage.
Dandelions	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in May or September.
Goat's-beard	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply as early as possible on the second year's growth or early fall on the first year's growth.
	dicamba BANVEL (400 g/L)	2.2 kg/ha 5.5 L/ha	Apply when actively growing. Wait 30 days between treatment and harvest for dairy animals. Do not slaughter meat animals fed with treated forage for 28 days after application.
Goldenrod	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in June.
	dicamba BANVEL (400 g/L)	1.1 kg/ha 2.8 L/ha	Apply when actively growing. Wait 14 days between treatment and harvest for dairy animals. Do not slaughter meat animals fed with treated forage for 28 days after application.
Hawkweeds	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 to 1.75 kg/ha 2.2 to 3.5 L/ha	Apply near the end of May and early September.
Leafy spurge	TBA TBA — 4 General Weed Killer (400 g/L)	11 to 22 kg/ha 28 to 56 L/ha	Apply to young growth. Residues may damage crops for a number of years.
	dicamba BANVEL (400 g/L)	0.6 kg/ha 1.5 L/ha	For top growth control apply when the weed is actively growing. Wait 7 days between treatment and harvest for dairy animals. Do not slaughter meat animals fed with treated forage for 28 days after herbicide application.
Milkweed	glyphosate ROUNDUP (356 g/L)	4.25 kg/ha 12.0 L/ha	Apply as a spot treatment when the milkweed is in the bud to bloom stage.
	amino triazole/ammonium thiocyanate CYTROL (240 g/L) AMITROL-T (240 g/L)	4.5 kg/ha 19 L/ha 19 L/ha	Spray to wet before flowering. Use spot treatments. Keep animals away from the treated area for 6 to 8 months.

	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply as a late spring application emphasizing spraying of the underside of leaves. This treatment kills top growth only.
Nodding, bull, and scotch thistle	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply late spring or early fall.
	2,4-DB 2,4-DB (500 g/L)	1.7 kg/ha 4.25 L/ha	Apply late spring or early fall.
Ox-eye daisy	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 to 1.75 kg/ha 2.2 to 3.5 L/ha	Use two treatments, one in mid-June and the second in early September if there is sufficient growth.
Tansy ragwort	2,4-D (LV ester) 2,4-D (500 g/L)	2.25 kg/ha 4.5 L/ha	Apply to rosettes in spring or fall. Retreatment will be necessary to control any new seedlings and regrowth.
	dicamba BANVEL (400 g/L)	1.1 kg/ha 2.8 L/ha	Apply when the tansy ragwort is actively growing. Wait 14 days between treatment and harvest for dairy animals. Do not slaughter meat animals fed with forage from treated areas for 28 days after treatment.
Water hemlock	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in May or June.
Wild carrot	2,4-D (LV ester) 2,4-D (500 g/L)	1.1 kg/ha 2.2 L/ha	Apply in early fall for first-year plants or early spring for second-year plants. If 2,4-D resistant strains are present mow to reduce seed spread.
Yellow rocket (winter cress)	2,4-D (LV ester) 2,4-D (500 g/L)	0.84 to 1.1 kg/ha 1.7 to 2.2 L/ha	September, October or in early May before flowering. Mow if the plants are in the flowering stage.

PASTURE RENOVATION WITH BIRD'S-FOOT TREFOIL

The introduction of this legume into a pasture requires control of competition from weeds and forage grasses for the first 2 to 4 months after the legume seed begins to germinate. Control of established perennial weeds should start at least one year before the legume seeding operation, using treatments recommended in the previous section of this publication. If the field cannot be plowed and worked to prepare a seedbed one of the following chemical treatments can be used to suppress the sod.

PASTURE RENOVATION WITH BIRD'S-FOOT TREFOIL (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Grass suppression	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	8.5 kg/ha 11.0 kg/ha 11.0 kg/ha	Apply in September. Broadcast seed and fertilizer in March. Do not feed forage to meat or dairy animals in the fall after application.
Grass and broadleaf suppression	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Broadcast seed and fertilizer in mid- April. Apply GRAMOXONE in early May.
Kill or suppression of grasses and broadleaf plants	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Apply in the spring when there is at least 20 cm of new growth. Trefoil may be seeded before, during or after spraying, but it must not be emerged at time of spraying.

The success of these programs depends on many management factors such as inoculation of the trefoil seed, and control of fertility and grazing. Consult local agricultural authorities for more information about pasture renovation.

FLAX-LINSEED

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Lady's-thumb, wild buckwheat and many other emerged broadleaf weeds.	bromoxynil TORCH (225 g/L)	0.28 kg/ha 1.25 L/ha	Apply before the weeds are developed beyond the 4-leaf stage when flax is 8 to 15 cm high. Some burn of flax leaves may be noted but new growth usually appears quickly.
Mustards, lady's-thumb, wild buckwheat and many other emerged broadleaf weeds	bromoxynil/MCPA (1:1) BUCTRIL M (450 g/L) BROMOX 450 M (450 g/L)	0.56 kg/ha 1.25 L/ha 1.25 L/ha	Apply when the flax is 5 to 10 cm high before weeds have developed beyond the 4-leaf stage. Do not use if the daytime temperature is over 29°C.
Mustard and many other emerged annual broadleaf weeds	MCPA MCPA (500 g/L)	0.42 to 0.56 kg/ha 0.84 to 1.1 L/ha	Flax may be treated when 5 cm tall to bud stage. Best weed control is obtained if the application is made when the weeds are small (approx. 5 cm tall).
	2,4-D 2,4-D (500 g/L)	0.35 kg/ha 0.70 L/ha	Treat when flax is 5 cm high to bud stage. Weeds should be small when sprayed (approx. 5 cm tall).

Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and some suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 to 1.1 kg/ha 1.75 to 2.25 L/ha 2 L/ha	Apply when the weeds are small and actively growing. Smartweed is controlled up to a height of 20 cm. Grasses are not controlled. Top growth of Canada thistle, yellow nutsedge and field bindweed is controlled but 2 applications 10 days apart may be required. A new flush of weeds may emerge after the first has been controlled. Cool weather or drought may delay control. Temporary crop injury may occur under hot, humid conditions.
Annual grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	0.85 to 1.5 kg/ha 1.1 to 2.0 kg/ha 1.1 to 2.0 kg/ha	Apply before the grasses are beyond the 3- leaf stage. These chemicals may be combined with MCPA and MCPB + MCPA for broadleaf control.
Wild oats	barban CARBYNE (240 g/L)	0.28 to 0.42 kg/ha 1.2 to 1.8 L/ha	Apply when wild oats are in the 2-leaf stage of growth. Do not mix this product with other herbicides. Consult the label for instructions about specific nozzles and other precautions.
	triallate AVADEX BW (400 g/L)	1.7 to 2.2 kg/ha 4.25 to 5.5 L/ha	Triallate can be applied before or after seeding and must be worked into the soil to control wild oats. Consult the label for complete directions.

PEAS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses Lamb's-quarters and pigweeds	trifluralin TREFLAN (545 g/L)	0.6 to 0.8 kg/ha 1.1 to 1.5 L/ha	Apply in 150 to 300 L water per hectare. Preplant-incorporated. See page 62 for information about the method of incorporation.
Germinating weeds	dinoseb AMINE DINITRO (300 g/L) AMINE DINITRO (360 g/L)	4.5 kg/ha 15.3 L/ha 12.6 L/ha	Apply in 400 L water per hectare. Preemergence treatment is applied 3 days before the crop emerges, and is most effective under favorable moisture conditions.
	prometryne GESAGARD (80 WP)	1.8 to 2.2 kg/ha 2.25 to 2.75 kg/ha	Apply in 200 to 300 L water per hectare. Preemergence.
Seedling annual weeds (may also check Canada thistle)	dinoseb AMINE DINITRO (300 g/L) AMINE DINITRO (360 g/L)	1.1 kg/ha 3.74 L/ha 3.08 L/ha	Apply in 400 to 600 L water per hectare. Postemergence treatment is applied when the peas are 10 to 15 cm high, on a warm, sunny day with temperatures not over 27°C.

PEAS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Many seedling annual broadleaf weeds	MCPA-sodium salt or MCPA amine MCPA (500 g/L)	not more than 0.375 kg/ha not more than 0.75 L/ha	Apply in 100 to 200 L water per hectare. Postemergence.
Many seedling annual broadleaf weeds and Canada thistle	MCPB sodium salt TROPOTOX (400 g/L) or MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.4 to 1.7 kg/ha 3.5 to 4.25 L/ha 1.1 to 1.7 kg/ha 2.75 to 4.25 L/ha	Apply in 200 L water per hectare. Apply when the peas have 3 to 6 expanded leaves and when the annual weeds are in the seedling stage. MCPB/MCPA gives better control of wild mustard than MCPB alone.
Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and suppression of field bindweed.	bentazon BASAGRAN (480 g/L)	0.84 to 1.1 kg/ha 1.75 to 2.25 L/ha	Apply in 200 to 400 L water per hectare postemergence after the peas have 3 pairs of leaves. A second application, 10 days later, may be necessary for nutsedge, Canada thistle and field bindweed. Bentazon is generally most effective if the weeds are small and actively growing at time of application. However, velvetleaf is controlled when up to 15 cm high, smartweed up to 20 cm and cocklebur up to 30 cm respectively. Grasses are not controlled with bentazon. Field bindweed should be 5 to 8 cm high (not vining) and Canada thistle and nutsedge should be 15 to 20 cm high at time of spraying. Cool weather and drought delay control and temporary crop injury may occur when bentazon is applied under extreme weather conditions. Since bentazon has little residual activity, a second application may be necessary to control annual broadleaf weeds that emerge after the first application.
Wild oats	triallate AVADEX BW (400 g/L)	1.5 to 1.75 kg/ha 3.75 to 4.37 L/ha	Apply in 150 to 200 L water per hectare, for dry peas only. Preplant-incorporated.
	barban CARBYNE (240 g/L)	0.28 to 0.42 kg/ha 1.2 to 1.8 L/ha	Apply in 40 to 50 L water per hectare and at least 300 kPa, when the wild oats are in the 2-leaf stage of growth. Barban will not kill wild oats which have only 1 leaf or more than 2 leaves at time of spraying. Do not mix barban with other herbicides. Consult the label for instructions about specific nozzles to use and other precautions.

Wild oats, green and yellow foxtail, barnyard grass, old witch grass and volunteer corn.	diclofop-methyl HOE-GRASS (190 g/L)	0.7 kg/ha 3.70 L/ha	For optimum weed control apply diclofop- methyl when the majority of the grass weeds are in the 2- to 3-leaf stage. Spray tips angled forward at 45° will give better coverage. Do not apply if rain is expected within one hour after application. Do not use tank mixes of diclofop-methyl and other herbicides. Other postemergence herbicides must be applied at least 4 days after diclofop-methyl.

CANOLA (RAPESEED)

Preplant Incorporated

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses	trifluralin TREFLAN (545 g/L)	0.8 to 1.1 kg/ha 1.5 to 2.1 L/ha	Trifluralin must be applied before planting and incorporated in the soil. See "Incorporated" page 45. Use the higher rate on clay soil and the lower rate on sandy or loam soils. Ragweed, annual nightshades, and mustards are not controlled, and lady's-thumb may escape. Control of annual grasses is usually excellent, and of lamb's-quarters and pigweed usually good including triazine-resistant varieties of these weeds.

CORN, FIELD AND SWEET

Weed control in corn has become increasingly reliant upon chemicals. Although chemicals by themselves can be effective, cultivation, rotation and other cultural practices should not be forgotten. Any single method of weed control or the continuous use of the same chemicals can lead to the buildup of weeds resistant or tolerant to that control method. Triazine-resistant lamb's-quarters and pigweed has become a problem as a result of continuous corn and the repeated use of triazine herbicides. Rotation to other crops and/or other control methods will reduce the chance of new or unique weed infestations.

High speed (10 kph) shallow (2.5 to 3 cm) cultivation with the rotary hoe when corn is 7 to 8 cm in height will help to control small weed seedlings. This technique will not reduce herbicide action and may in some years enhance chemical weed control.

Inter-row cultivation may be required when weeds escape herbicide treatment. Weeds should be considered as escapes when they are 7 to 10 cm high. Cultivation should be shallow to prevent exposure of untreated soil and germination of new weed seeds.

Band treatment of chemical over the row will reduce costs by one-half to two-thirds depending on the row-spacing and width of band. Shallow inter-row cultivation will be required to control weeds between the bands.

Cultivation will give some control of established perennial weeds but may also help to spread them to previously uninfested areas. Machinery sanitation is important when moving from one field to another. Many perennials can be spread on tillage equipment (i.e. nutsedge). Where possible it is always a good idea to till fields with perennial weeds last. Custom operators should be particularly careful when moving from one farm to another. For additional information see OMAF Factsheet, Long-term weed control planning, Agdex 641.

Sweet Corn Recommendations very closely parallel the recommendations for field corn. There are two differences that need to be noted: (1) the sensitivity of some sweet corn hybrids to 2,4-D and dicamba; and, (2) no general recommendations for using preemergence linuron due to injury on some sweet corn hybrids. Where 2,4-D, dicamba or linuron is being used two suggestions are made: (1) check local recommendations; (2) beware of 2,4-D or dicamba drift hazard. (See precautions in postemergence with 2,4-D section.)

Sweet corn most frequently is grown in areas where the crops in sequence are very sensitive to atrazine residues. Avoid using atrazine rates above 1.1 kg (active) per hectare (**2.2 L of (500 g/L) or 1.2 kg of (90 WP) PRODUCT**). (See notes on atrazine residues for suggestions.)

Seed Corn Recommendations Although most field corn recommendations are applicable to seed corn, there are inbreds which are susceptible to some chemicals. Check with the contracting company before applying any herbicide.

For information on specific weeds see Tables 3A to 3D and then refer to the appropriate section for details about herbicide treatment.

Preplanting

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Quack grass	amino triazole/ammonium thiocyanate	3.25 kg/ha	Apply to actively growing quack grass (15- 20 cm high) in the fall or spring. Plow or thoroughly disk 10-14 days after application. Cultivation may be required when the corn is 12 to 15 cm.
	AMITROL-T, CYTROL (240 g/L)	13.75 L/ha	

	glyphosate ROUNDUP (356 g/L)	1.70 to 2.50 kg/ha 4.75 to 7.0 L/ha	Apply in 200 to 300 L water per hectare in the fall previous to corn or in the spring before the crop is planted to actively growing quack grass with at least 4 new leaves per shoot. In fall, remove crop refuse but DO NOT till prior to application. Tillage can occur 5-7 days after treatment. Rainfall within 6 hours after application may reduce quack grass control. Other herbicides are necessary for annual weed control in the corn crop.
Quack grass and germinating annual broadleaf weeds	amino triazole/ammonium thiocyanate AMITROL-T, CYTROL (240 g/L) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	2.25 kg/ha 9.5 L/ha 2.25 kg/ha 4.5 L/ha 2.50 kg/ha	Apply amino triazole/ammonium thiocyanate to actively growing quack grass (15-20 cm high) in the spring and plow or cultivate 7 days later, then plant to corn. Follow by an application of atrazine (see early postermergence section). Cultivation will provide added effectiveness.
Quack grass, Canada thistle, and germinating annual broadleaf weeds and grasses	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	2.25 and 2.25 kg/ha 4.5 and 4.5 L/ha 2.50 and 2.50 kg/ha	Use the split application where corn is to follow corn. Apply the first 2.25 kg (active) for quack grass: (1) in the fall to sod or harvested field during the period from September 1 to November 1, then plow 1 to 3 weeks later; (2) in the spring to growing quack grass foliage (usually after mid-April). Wait at least 7 days before plowing or working. For Canada thistle use (1). After planting the corn make the second application in an oil-water emulsion (see postemergence section). Split applications of atrazine or amitrole-T are important because of harmful early nutrient competition between corn and quack grass. Where atrazine residues may be a problem the following year apply the amino triazole/ammonium thiocyanate treatment.

**Additional formulations are available. See Table 1 and use rates that give comparable amounts of active ingredient.*

TABLE 3A. CORN HERBICIDE WEED CONTROL RATINGS, (PRELANT OR SPLIT APPLICATIONS)

For complete information on rates and details of application, refer to pages 42 to 61. The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

			ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							
Treatment	Trade Name	Method[1] of Application	buckwheat, wild	corn spurry	lady's-thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweeds	triazine resistant	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	proso millet	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	CORN TOLERANCE
amitrole-T	Amitrol-T, Cytrol	preplant	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	G	*	*	E
glyphosate	Roundup	preplant	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	P	E	*	E	*	*	E
glyphosate	Roundup	spot treat or after harvest	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	E	P	E	G	E	E	E	P
amitrole and atrazine	Amitrol-T, Cytrol and atrazine[2]	split	E	E	E	E	E	E	E	E	P	F	G	P	P	G	G	P	P	P	P	F	G	P	P	E
atrazine and atrazine	atrazine and atrazine	split	E	E	E	E	E	E	E	E	P	F	E	F	F	E	E	P	F	F	F	G	E	G	G	E

[1] *Split = one preplant or the previous fall and the second applied early post.*

[2] *Various formulations available see Table 1.*

**Indicates the annual weeds will be controlled if emerged, and the perennials can be controlled if treated at the optimum time which is usually not the same time as for quack grass.*

Preplant Incorporated

Note: Unless specified, apply all treatments in 150 to 300 L of water per hectare. Two incorporations at right angles using a double disk or vibrating shank cultivator (S-tine type) are recommended. Cultivation-type equipment used for herbicide incorporation is known to spread perennial weeds to previously uninfested areas. Special attention should be directed toward machinery cleanliness and/or treating with incorporation the fields with perennial weeds last.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses	alachlor LASSO (480 g/L)	3.0 to 4.5 kg/ha 6.5 to 9.5 L/ha	Follow application with one shallow incorporation (equipment operating at 5 to 10 cm depth). Immediate incorporation is not necessary. Do not apply more than 7 days before planting. Alachlor lasts 8 to 12 weeks in the soil and gives fair control of some annual broadleaf weeds and nutsedge when used at the higher rate.
Nutsedge*, germinating annual broadleaf and grass weeds including crabgrass, fall panicum, and proso millet	butylate^{+} *** SUTAN^{+} (800 g/L) either plus atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP) or plus cyanazine BLADEX (480 g/L) BLADEX (80 WP)	3.4 to 6.8 kg/ha 4.25 to 8.5 L/ha 1.2 to1.8 kg/ha 2.25 to 3.6 L/ha 1.3 to 2.0 kg/ha 1.8 to 2.75 kg/ha 3.75 to 5.5 L/ha 2.25 to 3.25 kg/ha	Operate incorporation equipment at 10 to 15 cm depth and ensure good soil mixing. Use the lower rates for light weed infestations or on sand or loam soils. For annual grass control use butylate^{+} rate range of 3.4 to 4.4 kg/ha. For nutsedge or fall panicum use the higher rate range of 4.4 to 6.8 kg/ha. Any late emerging nutsedge will not likely reduce yields. For velvetleaf control use the higher rates of butylate^{+} plus atrazine. Butylate^{+} must be applied to a dry soil surface, incorporation may be delayed for no longer than one hour. To improve overall weed control atrazine or cyanazine should be used as a tank mix. Use the low rate of cyanazine on coarse-textured soils, particularly for sweet corn. Mid-season to late season germinating fall panicum or proso millet may not be controlled by butylate^{+}. Proso millet has been observed in Huron, Ontario, Perth, Waterloo, and Wellington counties and scattered areas throughout central and eastern Ontario. Usually good control of early emerging proso millet will be obtained. Cultivation or a directed post-application of linuron may be required to control later emerging proso millet.

CORN, FIELD AND SWEET (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	EPTC + *** ERADICANE (800 g/L)	3.40 to 6.80 kg/ha 4.25 to 8.5 L/ha	Operate incorporation equipment at 10 to 15 cm depth and ensure good soil mixing. Use lower rate for light weed infestations or on coarse-textured soils. Use the higher rate of EPTC + for nutsedge control or on clay soils or heavily infested grass areas. EPTC + must be applied to a dry soil surface, incorporation may be delayed for no longer than one hour. For specific rate ranges see butylate + above and check label. Usually, good control of early emerging proso millet will be obtained. Inter-row cultivation or directed post linuron may be required to control later emerging proso millet.
	metolachlor DUAL (960 g/L) plus atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP) or metolachlor/atrazine (1.5:1) PRIMEXTRA (500 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 1.1 to 1.75 kg/ha 2.25 to 3.75 L/ha 1.2 to 1.94 kg/ha 3.25 to 4.25 kg/ha 6.5 to 8.5 L/ha	Operate incorporation equipment at a 10 cm depth. One incorporation is sufficient and need not be immediate. Metolachlor controls grasses and atrazine controls the broadleaf weeds. When incorporated metolachlor will control nutsedge for most of the season (10-14 weeks), mid-season (July) germinating fall panicum may not be controlled. The high rate should be used where annual grass buildup or nutsedge infestation is evident.
	metolachlor DUAL (960 g/L) plus cyanazine BLADEX (480 g/L) BLADEX (80 WP)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 1.75 to 2.75 kg/ha 3.75 to 5.5 L/ha 2.25 to 3.25 kg/ha	Operate incorporation equipment at a 10 cm depth. One incorporation is sufficient and need not be immediate. Metolachlor controls the grasses and cyanazine controls the broadleaf weeds. Use the high rates of cyanazine for heavy weed infestations or on fine-textured soils. This treatment will give fair control of proso millet. See above treatment for additional notes.
Nutsedge*, germinating annual grasses including crabgrass and fall panicum	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha	Operate incorporation equipment at a 10 cm depth. One incorporation is sufficient and need not be immediate. Metolachlor controls mainly grasses. See above for additional notes.
Germinating annual broadleaf weeds and grasses including fall panicum, and nutsedge suppression	alachlor LASSO (480 g/L) plus atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP)	3.0 to 4.2 kg/ha 6.5 to 9.0 L/ha 1.4 to 2.0 kg/ha 2.8 to 4.0 L/ha 1.5 to 2.2 kg/ha	Operate incorporation equipment at a 5 to 10 cm depth. One incorporation is sufficient and need not be immediate. Alachlor controls the grasses and atrazine controls the broadleaf weeds. The upper rate of alachlor should be considered where grass buildup is evident, mid- season (July) germinating fall panicum may not be controlled. A higher rate of 3.25 to 4.50 kg/ha (6.75 to 9.5 L PRODUCT) of alachlor is required for an 8-12 week suppression of nutsedge.

Germinating annual broadleaf weeds and grasses. Crabgrass and fall panicum may escape.	atrazine/simazine (1:1) EKKO (80 WP)	3.25 kg/ha 4 kg/ha	Operate incorporation equipment at a 5 to 10 cm depth. One incorporation is sufficient and need not be immediate. Full season annual weed control can be expected except for crabgrass or fall panicum where infestations have built up. Simazine is more persistent than atrazine thus residues may be high and only corn should be planted the following year.
	cyanazine/atrazine (2:1) BLAZINE (480 g/L) BLAZINE (80 WP)	3.25 to 4 kg/ha 6.7 to 8.3 L/ha 4 to 5 kg/ha	Operate incorporation equipment at a 5 to 10 cm depth. One incorporation is sufficient and need not be immediate. This combination will improve barnyard grass and pigweed control over cyanazine alone. Use the lower rate on coarse-textured soils and high rate on medium to fine-textured soils. Do not use on muck or peat soils. Mid-season (July) germinating fall panicum may not be controlled.
Nutsedge* and germinating annual weeds	atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP) followed by atrazine** ATRAZINE (500 g/L) ATRAZINE (90 WP)	 2.25 kg/ha 4.5 L/ha 2.50 kg/ha 2.25 kg/ha 4.5 L/ha 2.50 kg/ha	Applied in a split application with the first treatment incorporated with equipment operating at a depth of 10 to 15 cm in the spring before shoots emerge. The second application to be made postemergence in an oil- water emulsion when the nutsedge is 15 cm high. Cultivation may be necessary for good nutsedge control. This total amount of atrazine will control germinating annuals but corn should follow corn because of possible residues.

Dry bulk fertilizers may be impregnated or coated with butylate$^+$, butylate$^+$ plus atrazine or cyanazine. Check the label for recommended fertilizer ingredients. This service must be supplied by a fertilizer blender and accurate application of the fertilizer is necessary.

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* *Nutsedge is impossible to eradicate in a single season, because of dormant underground tubers. One-season control can be obtained and competition eliminated by using alachlor, butylate$^+$, EPTC$^+$, metolachlor or the split application of atrazine. Such methods should be used every year where nutsedge is a serious problem (see notes on atrazine residues).*

** *Additional formulations are available. Use rates that give comparable amounts of active ingredient. (See Table 1.)*

****An antidote (safening agent) has been added to both butylate$^+$ and EPTC$^+$ to prevent corn injury.*

TABLE 3B. CORN HERBICIDE WEED CONTROL RATINGS (PREPLANT INCORPORATED APPLICATIONS)

For **complete information** on rates and details of application, refer to pages 42 to 61. The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Method[1] of Application	ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							CORN TOLERANCE
			buckwheat, wild	corn spurry	lady's-thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweeds	triazine resistant	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	proso millet	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	
alachlor + atrazine	Lasso + atrazine[2]	ppi	E	E	E	E	E	E	E	E	P	F	E	E	G	E	E	P	P	P	P	F	P	P	P	E
atrazine/simazine	Ekko	ppi	E	E	E	E	E	E	E	E	P	F	E	E	F	E	E	P	P	P	P	F	F	P	P	E
butylate$^+$	Sutan$^+$	ppi	P	G	P	F	P	G	F	F	P	P	E	E	G	E	E	F	P	P	P	G	P	P	P	E
butylate$^+$ plus atrazine	Sutan$^+$ plus atrazine	ppi	E	E	E	E	E	E	G	G	P	G	E	E	G	E	E	F	P	P	P	G	F	P	P	E
butylate$^+$ plus cyanazine	Sutan$^+$ plus Bladex	ppi	-	-	-	E	E	E	F	E	P	F	E	E	G	E	E	F	P	P	P	G	P	P	P	E
cyanazine/atrazine	Blazine	ppi	E	E	E	E	E	E	E	E	P	F	G	E	G	E	E	P	P	P	P	P	P	P	P	E
EPTC$^+$	Eradicane	ppi	P	G	F	G	P	G	F	F	P	P	E	E	G	E	E	F	P	F	P	G	P	P	P	E
EPTC$^+$ plus atrazine	Eradicane plus atrazine	ppi	E	E	E	E	E	E	G	G	P	P	E	E	G	E	E	F	P	F	P	G	F	P	P	E
EPTC$^+$ plus cyanazine	Eradicane plus Bladex	ppi	-	-	-	E	E	E	F	E	P	P	E	E	G	E	E	F	P	F	P	G	P	P	P	E
metolachlor	Dual	ppi	P	P	P	P	P	G	P	P	P	P	E	E	G	E	E	P	P	P	P	G	P	P	P	E
metolachlor + or/atrazine	Dual + atrazine or Primextra	ppi	E	E	E	E	E	E	E	E	P	F	E	E	G	E	E	P	P	P	P	G	P	P	P	E
metolachlor + cyanazine	Dual + Bladex	ppi	E	-	E	E	E	E	G	E	P	F	E	E	G	E	E	P	P	P	P	G	P	P	P	E

[1] *ppi = preplant incorporated*

[2] *Various formulations available, see Table 1.*

Preemergence

Note: Apply all treatments in 150 to 300 L water per hectare except where otherwise noted.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual weeds including crabgrass, fall panicum and triazine-resistant broadleaf weeds	alachlor LASSO (480 g/L) plus dicamba BANVEL (400 g/L)	2.4 to 3.4 kg/ha 5.0 to 7.0 L/ha 0.6 kg/ha 1.5 L/ha	Alachlor controls the grasses and dicamba controls the broadleaf weeds. DO NOT apply to sand or sandy loam soils or to sweet corn. DO NOT incorporate. Dicamba controls velvetleaf and triazine (atrazine, cyanazine, or simazine) resistant broadleaf weeds. Higher rates of alachlor should be used on fine soils and heavy grass infestations. Alachlor and dicamba are short-lived and will disappear before the end of the season thus fall panicum may not be controlled all season.
	cyanazine BLADEX (480 g/L) BLADEX (80 WP) plus dicamba BANVEL (400 g/L)	2.25 to 3.25 kg/ha 4.75 to 7.0 L/ha 2.75 to 4.25 kg/ha 0.6 kg/ha 1.5 L/ha	Cyanazine controls most annual grasses and broadleaf weeds. Barnyard grass may not be adequately controlled. Use higher rates on fine soils and heavy weed infestations. DO NOT incorporate this tank-mix or use on sand or sandy loam soils or on sweet corn. Cyanazine and dicamba are short-lived and will disappear before the end of the season thus fall panicum may not be controlled all season. Dicamba controls velvetleaf and triazine (atrazine, cyanazine or simazine) resistant broadleaf weeds. See below for additional notes on cyanazine.
	metolachlor DUAL (960 g/L) plus dicamba BANVEL (400 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 0.6 kg/ha 1.5 L/ha	Metolachlor controls annual grasses and the mixture with dicamba controls annual broadleaf weeds. DO NOT use this tank-mix on sand or sandy loam soil or on sweet corn. High rates should be used on heavy grass infestations and for fall panicum. Fall panicum may not be controlled all season. Dicamba controls velvetleaf and triazine (atrazine, cyanazine or simazine) resistant broadleaf weeds.
Germinating annual grasses including fall panicum and crabgrass	alachlor LASSO (480 g/L) LASSO (15 G)	2.4 to 3.8 kg/ha 5.0 to 8.0 L/ha 17 to 30 kg/ha	Alachlor controls annual grasses. Apply along with atrazine, cyanazine or dicamba for broadleaf control. Fall panicum may not be controlled all season. For maximum activity rainfall is required within 10 days after application. High rates should be used on fine soils or where heavy grass infestations occur. The GRANULAR formulation must be applied with a special granular applicator and MUST NOT be mixed with water.

CORN, FIELD AND SWEET (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha	Metolachlor controls annual grasses. Apply along with atrazine, cyanazine, or dicamba for broadleaf control. Fall panicum may not be controlled all season. For maximum activity rainfall is required within 10 days after application. High rates should be used where heavy grass infestations occur or for fall panicum.
Germinating annual weeds including crabgrass and fall pancium	alachlor LASSO (480 g/L) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	2.4 to 3.0 kg/ha 5.0 to 6.25 L/ha 1.2 to 1.8 kg/ha 2.2 to 2.5 L/ha 1.3 to 2.0 kg/ha	Alachlor controls annual grasses and atrazine controls most annual broadleaf weeds. This tank-mix should be considered where a buildup of grasses is evident. See above for additional remarks on alachlor.
	alachlor LASSO (480 g/L) plus cyanazine BLADEX (480 g/L) BLADEX (80 WP)	1.70 to 2.6 kg/ha 3.5 to 5.5 L/ha 1.75 to 2.25 kg/ha 3.75 to 4.75 L/ha 2.25 to 2.75 kg/ha	Alachlor controls annual grasses and cyanazine controls most annual grasses and broadleaf weeds. This tank-mix should be considered where a buildup of grasses is evident. The tank-mix is short-lived in the soil and may not control fall panicum for the full season. See other treatments for additional information on alachlor or cyanazine.
	cyanazine BLADEX (480 g/L) BLADEX (80 WP)	2.25 to 3.25 kg/ha 4.75 to 7.0 L/ha 2.75 to 4.25 kg/ha	Cyanazine controls most annual grasses and broadleaf weeds. Barnyard grass and redroot pigweed may escape. Use the low rate on coarse-textured soils and on sweet corn. Cyanazine is not recommended alone for fine- textured or for muck soils. Cyanazine is relatively short-lived and may not control fall panicum for the full season. For maximum activity rainfall is required within 10 days after application. See other treatments for appropriate tank-mixes.
	cyanazine BLADEX (480 g/L) BLADEX (80 WP) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) or cyanazine/atrazine (2:1) BLAZINE (480 g/L) BLAZINE (80 WP)	2.25 kg/ha 4.75 L/ha 2.75 kg/ha 1.1 kg/ha 2.25 L/ha 1.2 kg/ha 3.25 kg/ha 7.0 L/ha 4.25 kg/ha	The tank-mix of cyanazine plus atrazine or the formulated mix of cyanazine/atrazine will improve control on fine-textured soils and control of barnyard grass and redroot pigweed. DO NOT use the mixture on muck or peat soils. Fall panicum may not be controlled for the full season.

	metolachlor DUAL (960 g/L) atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) or metolachlor/atrazine (1.5:1) PRIMEXTRA (500 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 1.1 to 1.75 kg/ha 2.2 to 3.5 L/ha 1.2 to 1.94 kg/ha 3.25 to 4.25 kg/ha 6.5 to 8.5 L/ha	The tank-mix of metolachlor plus atrazine or formulated mix metolachlor/atrazine is effective over a wide range of soil types and has a good margin of crop safety. Rainfall within 10 days is required for maximum activity. High rates should be used for heavy grass infestation areas and for fall panicum control. Fall panicum may not be controlled for the full season.
	metolachlor DUAL (960 g/L) plus cyanazine BLADEX (480 g/L) BLADEX (80 WP)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha 1.75 to 2.25 kg/ha 3.75 to 4.75 L/ha 2.25 to 2.75 kg/ha	The tank-mix of metolachlor plus cyanazine will control annual grass and broadleaf weeds. Fall panicum may not be controlled for the full season. High rates should be used for heavy grass infestation areas and for fall panicum control or on fine-textured soils.
Germinating annual broadleaf weeds and some grasses. Crabgrass and fall panicum may escape.	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	1.75 to 2.25 kg/ha 3.5 to 4.5 L/ha 1.94 to 2.5 kg/ha	Weeds will normally emerge and die within a few days; atrazine can persist for varying lengths of time; longer under dry, cool weather and coarse-textured soils. Granular formulations give longer residues than liquids or wettable powders. See tank-mixes for reducing rates and avoiding residues. Annual grasses, especially crabgrass and fall panicum, are likely to escape.
	atrazine/simazine (1:1) EKKO (80 WP)	3.25 kg/ha 4 kg/ha	Gives full season annual weed control except for heavy infestations of crabgrass and fall panicum. Soil residues may be high and only corn should be planted the following year.
	linuron** AFOLAN F (450 g/L) LOROX (50 WP) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	1.1 kg/ha 2.4 L/ha 2.2 kg/ha 1.1 kg/ha 2.2 L/ha 1.2 kg/ha	Use this tank-mix only on clay or clay loam soil to avoid injury. See notes on sweet corn. This tank-mix controls annual weeds and is a method of reducing atrazine residues. Annual grasses will be the first weeds to escape.

** Additional formulations are available. Use rates that give comparable amounts of active ingredient. See Table 1.*

*** AFOLAN (190 g/L) equivalent rate is 5.8 L/ha. Lorox L (480 g/L) equivalent rate is 2.25 L/ha.*

NITROGEN solution can be used as a carrier instead of water for preplant and preemergence application of some herbicides. Weed control activity is not increased. Spraying should be done before crop emergence. Consult the herbicide label as to proper methods of application and use of dispersing agents. Calibrate the sprayer to apply the required amount of NITROGEN. Stainless steel flood jet nozzles of adequate size (e.g. Teejet TK SS 5 to TK SS 10) should be used. The NITROGEN solution is mildly corrosive, especially to brass and the sprayer should be cleaned immediately after use.

UNITE may be used as an aid in improving liquid fertilizer-herbicide compatibility and stability when a simultaneous application of a liquid fertilizer and liquid or wettable powder herbicide is desired. Because formulations and rates vary, it is essential to read the label to determine the exact amount and method to be used. DO NOT apply with postemergence herbicides.

TABLE 3C. CORN HERBICIDE WEED CONTROL RATINGS (PREEMERGENCE APPLICATIONS)

For complete information on rates and details of application, refer to pages 42 to 61. The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

			ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							
Treatment	Trade Name	Method[1] of Application	buckwheat, wild	corn spurry	lady's-thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweeds	triazine resistant	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	proso millet	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	CORN TOLERANCE
alachlor	LASSO	pre	P	P	P	P	P	G	P	P	P	P	E	E	G	E	E	P	P	P	P	P	P	P	P	E
alachlor + atrazine	LASSO + atrazine[2]	pre	E	E	E	E	E	E	E	E	P	F	E	E	G	E	E	P	P	P	P	P	P	P	P	E
alachlor + cyanazine	LASSO + BLADEX	pre	G	-	G	E	E	E	G	E	P	F	E	E	G	E	E	P	P	P	P	P	P	P	P	E
alachlor + dicamba	LASSO + BANVEL	pre	G	G	E	E	E	G	E	E	E	G	E	E	G	E	E	P	P	P	P	P	P	P	P	E
atrazine	atrazine	pre	E	E	E	E	E	E	E	E	P	F	G	P	P	G	G	P	P	P	P	P	F	P	P	E
atrazine/simazine	EKKO	pre	E	E	E	E	E	E	E	E	P	F	E	F	F	E	E	P	P	P	P	F	F	P	P	E
cyanazine	BLADEX	pre	G	-	G	E	E	E	F	E	P	F	F	E	G	E	E	P	P	P	P	P	P	P	P	E
cyanazine + or/atrazine	BLADEX + atrazine or BLAZINE	pre	E	E	E	E	E	E	E	E	P	F	G	E	G	E	E	P	P	P	P	P	P	P	P	E
cyanazine + dicamba	BLADEX + BANVEL	pre	G	E	E	E	E	E	E	E	E	G	F	E	G	E	E	P	P	P	P	P	P	P	P	E
linuron + atrazine	AFOLAN, LOROX + atrazine	pre	E	-	E	E	E	G	E	E	F	F	F	F	F	F	F	P	P	P	P	P	P	P	P	G
metolachlor	DUAL	pre	P	P	P	P	P	G	P	P	P	P	E	E	G	E	E	P	P	P	P	P	P	P	P	E
metolachlor + or/atrazine	DUAL + atrazine or PRIMEXTRA	pre	E	E	E	E	E	E	E	E	P	F	E	E	G	E	E	P	P	P	P	P	P	P	P	E
metolachlor + cyanazine	DUAL + BLADEX	pre	E	-	E	E	E	E	G	E	P	F	E	E	G	E	E	P	P	P	P	P	P	P	P	E
metolachlor + dicamba	DUAL + BANVEL	pre	G	G	E	E	E	E	E	E	E	G	E	E	G	E	E	P	P	P	P	P	P	P	P	E

[1] *pre = preemergence*

[2] *Various formulations available. See Table 1.*

Postemergence

Note: Apply all treatments in 150 to 300 L water per hectare unless specified otherwise.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Seedling annual broadleaf weeds (5 to 10 cm) and emerging grasses. Crabgrass and fall panicum may escape.	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP)	1.75 to 2.25 kg/ha 3.5 to 4.5 L/ha 1.94 to 2.5 kg/ha	Atrazine applied before the grasses reach the 1-leaf stage will provide good to excellent weed control, broadleaves up to 10 cm in height will be controlled. Under cold and adverse weather conditions, use atrazine alone to avoid crop injury otherwise see treatment below.
Seedling anual broadleaf weeds (5 to 10 cm) and grasses 1- to 3-leaf stage. Crabgrass and fall panicum may escape.	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) plus oil	1.1 to 2.5 kg/ha 2.2 to 5.0 L/ha 1.2 to 2.8 kg/ha	For increased activity and extended period of activity, particularly on annual grasses, apply in an oil-water emulsion of 10 to 15 L of emulsifiable light mineral oil and 150 to 200 L of water per hectare. Available as a formulated mixture such as ATRA-MIX. Apply when most weeds have emerged. Time of spraying is based on grass growth; broadleaf weeds are very susceptible. The low rate can be used successfully with later cultivation. Heavy infestations of crabgrass and fall panicum may not be controlled.
	atrazine/simazine (1:1) EKKO (80 WP) plus oil	2.75 kg/ha 3.25 kg/ha	Apply in oil-water emulsion. See atrazine above. Simazine is more persistent than atrazine. CORN should be planted again the next year. See notes on atrazine and simazine soil residues, page 59.
Emergency quack grass control	atrazine* ATRAZINE (500 g/L) ATRAZINE (90 WP) plus oil	4.5 kg/ha 9.0 L/ha 5.0 kg/ha	Add 15 L per hectare of an emulsifiable mineral oil to the water and apply to emerged heavy quack grass stands. This treatment is not as effective as a carefully planned split application. Severe corn injury may occur and corn must follow the next year.
Seedling annual weeds including crabgrass and fall panicum; broadleaf weeds 5 to 10 cm; grasses maximum 2- leaf stage	alachlor LASSO (480 g/L) plus atrazine* ATRAZINE (90 WP)	2.4 to 3.0 kg/ha 5.0 to 6.25 L/ha 1.2 to 1.8 kg/ha 1.3 to 2.0 kg/ha	This tank-mix controls annual weeds if applied before grasses reach the 2-leaf stage. Use the higher rates where annual grass infestations are heavy. DO NOT add oil or surfactants to this mixture. Corn should not be beyond the 5-leaf stage. Temporary corn leaf spotting may occur. Fall panicum may not be controlled for the full season.
	cyanazine BLADEX (80 WP)	2.25 kg/ha 2.75 kg/ha	Use only the wettable powder as the suspension may cause corn burning. DO NOT add oil or surfactants. DO NOT treat corn beyond the 3-leaf stage. Corn injury may occur during cold weather and under flooding conditions.

CORN, FIELD AND SWEET (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	cyanazine BLADEX (80 WP) plus atrazine* ATRAZINE (90 WP) or cyanazine/atrazine (2:1) BLAZINE (80 WP)	1.75 to 2.25 kg/ha 2.25 to 2.75 kg/ha 1.1 kg/ha 1.2 kg/ha 2.75 to 3.25 kg/ha 3.25 to 4.25 kg/ha	Use the wettable powder formulation. Excellent control of annual weeds can be obtained if applied before grasses reach the 2- leaf stage. Use the low rate on coarse-textured soils. DO NOT treat corn beyond the 3-leaf stage. Use this triazine mixture where barnyard grass may be a problem. DO NOT add oil or surfactants. Corn injury may occur during cold weather and under flooding conditions.
Seedling annual weeds including crabgrass, fall panicum and triazine-resistant broadleaf weeds; grasses maximum 2-leaf stage	cyanazine BLADEX (80 WP) plus dicamba BANVEL (400 g/L)	2.25 kg/ha 2.75 kg/ha 0.28 kg/ha 0.7 L/ha	Use the wettable powder formulation of cyanazine. Excellent control of annual weeds can be obtained if applied before grasses reach the 2-leaf stage. Dicamba will control velvetleaf and triazine-resistant broadleaf annual weeds. DO NOT apply to sweet corn. DO NOT add oil or surfactant. DO NOT treat field corn beyond the 3-leaf stage.
Emerged broadleaf annuals including triazine-resistant strains	bromoxynil PARDNER (225 g/L) bromoxynil TORCH (227 g/L)	0.28 to 0.34 kg/ha 1.25 to 1.5 L/ha 0.34 to 0.40 kg/ha 1.5 to 1.75 L/ha	Controls most annual broadleaf weeds including triazine-resistant species at the 1- to 4-leaf stage. Apply when corn is in the 4- to 8- leaf stage. Application during drought stress, high humidity or high temperature, particularly to corn with fewer than 4 leaves, may cause injury to the crop. Use the higher rate at later leaf stages. Bromoxynil is a contact herbicide and is non-volatile.
Emerged broadleaf annuals including triazine-resistant strains, 1- to 4-leaf stage; grasses 1- to 3-leaf stage. Crabgrass and fall panicum may escape.	bromoxynil PARDNER (225 g/L) plus atrazine* ATRAZINE (500 g/L) ATRAZINE (90WP)	0.28 to 0.34 kg/ha 1.25 to 1.5 L/ha 1.75 to 2.25 kg/ha 3.5 to 4.5 L/ha 1.94 to 2.5 kg/ha	Controls most annual broadleaf weeds including triazine-resistant species up to the 4- leaf stage and grasses up to the 3-leaf stage. DO NOT add oil or surfactant. Crop injury may occur to corn with fewer than 4 leaves or during periods of drought, high humidity or high temperature. Use the higher rate at later leaf stages or on heavy infestations.
Emerged annual broadleaf weeds including triazine-resistant strains; nutsedge, Canada thistle, and suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha 2 L/ha	Reduce oil concentrate to 1 L/ha of spray solution under hot, humid weather conditions. Apply to corn at the 1- to 5-leaf stage. Control is best when broadleaves are small and actively growing. Velvetleaf (15 cm), smartweed (20 cm) or cocklebur (30 cm) in height can be controlled. Grasses are NOT controlled. Bindweed should not be vining and Canada thistle or nutsedge should be 15 to 20 cm high when sprayed for top growth control and 2 applications 10 days apart may be required. A new flush of weeds may emerge after the first flush has been controlled. Temporary injury may occur under hot humid weather conditions. Cool weather and drought may delay control.

	bentazon/ atrazine (1:1) LADDOK (400 g/L) plus oil concentrate ASSIST	1.2 to 1.60 kg/ha 3 to 4 L/ha 2 L/ha	Apply when weeds are small and actively growing. Triazine-resistant strains will be controlled. See bentazon or atrazine for additional remarks.
Emerged broadleaf annuals including triazine-resistant strains and some broadleaf perennials	2,4-D* 2,4-D (500 g/L)	0.50 kg/ha 1.0 L/ha	DO NOT use more than suggested rate. Use amine formulation. See special notes on postemergence use of 2,4-D and related hormone chemicals. DO NOT add oil or surfactant.
Emerged broadleaf annuals including triazine-resistant strains, Canada thistle, sow thistle, field bindweed, and wild buckwheat	MCPB/MCPA (15:1) TROPOTOX PLUS (400 g/L)	1.1 to 1.70 kg/ha 2.75 to 4.25 L/ha	Apply when corn is 30 to 60 cm high, using drop pipes. See special notes on postemergence use of MCPB/MCPA and related hormone chemicals. DO NOT add oil or surfactant. Some control of field horsetail may be obtained with the higher rates of MCPB/MCPA.
	2,4-DB* 2,4-DB (400 g/L)	1.1 to 1.50 kg/ha 2.75 to 3.75 L/ha	See remarks for MCPB/MCPA and special notes on postemergence use of 2,4-DB and related hormone chemicals. DO NOT add oil or surfactant. 2,4-DB will not control field horsetail.
Emerged broadleaf annuals including triazine-resistant strains, sow- thistle, field bindweed, wild buckwheat, and lady's-thumb.	dicamba/2,4-D/mecoprop KIL-MOR (500 g/L)	0.55 kg/ha 1.1 L/ha	Apply as an overall spray until corn is 15 cm high (leaf extended), thereafter use drop nozzles. DO NOT add oil or surfactant. See special notes on postemergence use of dicamba and related hormone chemicals.
	dicamba BANVEL (400 g/L)	0.28 kg/ha 0.7 L/ha	Application can be made up to 15 cm tall corn. Drop pipes should be used when corn is 15 cm to 75 cm tall. DO NOT use on sweet corn or add oil or surfactant. See special notes on postemergence use of dicamba and related hormone chemicals. DO NOT use dicamba if temperature exceeds 25°C at the time of application and if susceptible crops are nearby. See precautions on page 59.
	dicamba BANVEL (400 g/L) plus 2,4-D 2,4-D (500 g/L)	0.14 kg/ha 0.35 L/ha 0.4 kg/ha acid 0.8 L/ha	Application can be made up to 15 cm tall corn. Drop pipes should be used when corn is 15 cm to 75 cm tall. DO NOT use on sweet corn or add oil or surfactant. Use amine formulation of 2,4-D. See special notes on postemergence use of dicamba and 2,4-D and related hormone chemicals. See precautions on page 59.

CORN, FIELD AND SWEET (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	linuron** AFOLAN F (450 g/L) LOROX (50 WP)	1.1 to 2.25 kg/ha 2.4 to 5.0 L/ha 2.20 to 4.5 kg/ha	See directed postemergence.

**Additional formulations are available. See Table I and use rates that give comparable amounts of active ingredient.*

***AFOLAN (190 g/L) equivalent rate is 5.8 to 12 L/ha. LOROX L (480 g/L) equivalent rate is 2.25 to 4.7 L/ha.*

Directed Postemergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged weed vegetation including nutsedge (up to 15 cm high) and horsetail	linuron* AFOLAN F (450 g/L) LOROX (50 WP)	1.1 to 2.25 kg/ha 2.4 to 5.0 L/ha 2.20 to 4.5 kg/ha	Apply in oil-water emulsion as a directed spray at low pressure with drop nozzles after corn is 30 cm or more in height. The spray must be placed under the corn leaves but on the weeds. Use this treatment as a rescue from weeds escaping a previous treatment. DO NOT apply linuron after corn is beginning to tassel. Follow label directions carefully.

**AFOLAN (190 g/L) equivalent rate is 5.8 to 12 L/ha. LOROX L (480 g/L) equivalent rate is 2.25 to 4.7 L/ha.*

Spot Treatment

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged Canada thistle, milkweed and field bindweed	glyphosate ROUNDUP (356 g/L)	Canada Thistle 1.7 to 2.5 kg/ha milkweed and field bindweed 2.5 to 4.25 kg/ha Canada thistle 4.75 to 7.0 L/ha milkweed and field bindweed 7.0 to 12.0 L/ha	DO NOT apply after corn has started to silk. Corn will be killed in the areas sprayed and may be damaged by spray drift in adjacent areas. Knapsack application of 100 mL ROUNDUP in 5 L of water applied to thoroughly wet the foliage, but not to run off, is suggested for small areas to reduce drift and area of corn killed. Apply after field bindweed has reached full flowering, Canada thistle has started flowering or milkweed has reached the bud stage.

TABLE 3D. CORN HERBICIDE WEED CONTROL RATINGS (POSTEMERGENCE APPLICATIONS)

For complete information on rates and details of application, refer to pages 42 to 61. The chemical ratings in this chart give general comparisons based on use as described in this guide. Under unfavorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

			ANNUAL BROADLEAVES										ANNUAL GRASSES						PERENNIALS							
Treatment	Trade Name	Method[1] of Application	buckwheat, wild	corn spurry	lady's-thumb	lamb's-quarters	mustards	nightshades	pigweeds	ragweeds	triazine resistant	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	Old witch grass	proso millet	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle, Canada	CORN TOLERANCE
alachlor + atrazine	LASSO + atrazine[3]	post	E	E	E	E	E	E	E	E	P	F	E	E	G	E	E	P	P	P	P	F	F	F	P	E
atrazine	atrazine[3]	post	E	E	E	E	E	E	E	E	P	F	G	P	P	F	G	P	P	P	P	F	F	F	P	E
atrazine + oil	atrazine + oil[3]	post	E	E	E	E	E	E	E	E	P	F	E	P	P	G	G	P	F	F	P	F	F	F	P	G
atrazine/simazine + oil	EKKO + oil	post	E	E	E	E	E	E	E	E	P	G	E	F	F	E	E	P	P	F	P	F	F	F	F	G
bentazon	BASAGRAN	post	F	-	E	G	E	G	G	E	E	E	P	P	P	P	P	P	G[2]	P	P	G[2]	P	G[2]	G[2]	E

TABLE 3D. CORN HERBICIDE WEED CONTROL RATINGS (POSTEMERGENCE APPLICATIONS) (Cont'd)

bentazon/atrazine	LADDOK	post	E	E	E	E	E	E	E	E	E	E	G	P	P	F	G	P	F	P	P	G[2]	P	F	F	E
bromoxynil	PARDNER, TORCH	post	E	-	E	E	G	E	G	E	E	E	P	P	P	P	P	P	F	P	P	P	P	F	F	E
bromoxynil + atrazine	PARDNER + atrazine[3]	post	E	E	E	E	E	E	E	E	E	E	G	P	P	G	G	P	F	P	P	P	P	F	F	E
cyanazine	BLADEX	post	G	-	G	E	E	E	F	E	P	G	F	E	G	E	E	P	P	P	P	P	P	P	P	G
cyanazine + or/atrazine	BLADEX + atrazine[3] or BLAZINE	post	E	E	E	E	E	E	E	E	P	G	G	E	G	E	E	P	P	P	P	P	P	P	P	G
cyanazine + dicamba	BLADEX + BANVEL	post	E	E	E	E	E	E	E	E	E	E	F	E	G	E	E	P	P	P	P	P	P	P	P	G
2,4-D	2,4-D[3]	post	F	P	F	E	E	E	E	E	G	E	P	P	P	P	P	P	F	P	P	P	P	G	G	G
2,4-DB, MCPB	2,4-DB[3], MCPB[3]	post	G	P	P	E	G	E	E	E	E	E	P	P	P	P	P	P	G	P	P	P	P	G	G	G
dicamba	BANVEL	post	E	E	E	E	E	E	E	E	E	E	P	P	P	P	P	P	G	P	P	P	P	E	G	E
dicamba + 2,4-D	BANVEL + 2,4-D[3]	post	E	E	E	E	E	E	E	E	E	E	P	P	P	P	P	P	G	P	P	P	P	E	G	G
2,4-D/mecoprop/dicamba	KIL-MOR	post	E	E	E	E	E	E	E	E	E	E	P	P	P	P	P	P	E	P	P	P	P	E	G	G
linuron	AFOLAN, LOROX	dir-post	E	E	E	E	E	E	E	E	E	E	E	F	E	G	E	G	F	E	F	G	F	G	F	G

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[1] *post = postemergence, dir-post = directed post*

[2] *Good control of these perennials may require two applications of bentazon + ASSIST about 7 to 10 days apart.*

[3] *Various formulations available, see Table 1.*

Split Applications

Preplant-incorporated herbicide treatments followed by preemergence or postemergence treatments offer many split applications or sequential combinations or programs. Similarly preemergence treatments may be followed by postemergence herbicides for broad- spectrum weed control. The combination of a herbicide whose strength is killing annual grasses with a herbicide whose strength is mainly broadleaf and/or triazine-resistant weed control is recommended. See recommendations on preceding pages for details about each herbicide.

Herbicides Controlling Most Annual Grasses	**Applied**	**Herbicides Controlling Most Annual Broadleaf Weeds**	**Applied**
butylate + (SUTAN +)	ppi	atrazine*	ppi, pre, post
EPTC + (ERADICANE)	ppi	cyanazine (BLADEX)	ppi, pre, post
alachlor (LASSO)	ppi, pre	simazine*	ppi, pre, post

metolachlor (DUAL)	ppi, pre	dicamba (BANVEL)	pre, post
		linuron*	pre, dir. post
		bentazon (BASAGRAN)	post
		bentazon/atrazine (LADDOK)	post
		bromoxynil*	post
		2,4-D*	post
		2,4-DB*	post
		MCPB/MCPA (TROPOTOX PLUS)	post
		2,4-D/mecoprop/dicamba*	post

For sequential or split applications use one herbicide from the left-hand column for annual grass control and combine or program it with one of the herbicides from the right-hand column for annual broadleaf weed control. DO NOT TANK-MIX ANY OF THE COMBINATIONS NOT REGISTERED OR RECOMMENDED.

** Additional formulations are available. See Table 1 and use rates that give comparable amounts of active ingredient.*

SPECIAL NOTES FOR CORN

POSTEMERGENCE WITH 2,4-D, MCPB, 2,4-DB, DICAMBA AND KIL-MOR

2,4-D, 2,4-DB, MCPB, dicamba, KIL-MOR and some mixtures are needed for control of such weeds as thistles, field bindweed, and triazine-resistant weeds.

Postemergence treatment with 2,4-D can be combined with cultural practices for the control of a wide range of weeds. After the crop is sown, use the rotary hoe, finger weeder, or light harrows to control weed seedlings until the corn is about 15 cm high (leaf extended). Then apply an overall spray of 2,4-D.

Some varieties of corn become increasingly susceptible to damage from 2,4-D beyond the 15 cm height (leaf extended) but if many broadleaf weeds are present in the rows, spraying is still recommended provided that drop pipes are used on the sprayer to direct the spray to the base of each plant, thus missing the corn leaves.

Do not cultivate until at least 2 weeks after a 2,4-D spray treatment, and then only if necessary. Corn is often brittle for a period of time after spraying and may be damaged by equipment. Cultivation may also damage the shallow feeding roots of corn, as well as bringing ungerminated weed seeds to the ground surface.

Following a period of drought, avoid 2,4-D application for at least a week after a good rain or irrigation.

The recommended 2,4-D treatments will control the top growth and reduce the competition of the more common perennial weeds (except quack grass).

2,4-DB and mixtures of MCPB and MCPA (15:1) can be used on corn at higher rates than 2,4-D and therefore will give better control of Canada thistle, sow-thistle, field bindweed and wild buckwheat. These materials should be applied when the corn is 30 to 60 cm high, using drop pipes. Spot treatment is often possible.

Dicamba, dicamba + 2,4-D tank mix or KIL-MOR provide good control of such difficult weeds as field bindweed and Canada thistle. They can be applied as an overall spray until the corn is 15 cm high (leaf extended) but **should be used with drop pipes** when Canada thistle is in the bud stage and field bindweed is at the early flowering stage. Corn will usually be above 40 cm in height.

Precautions

DO NOT use 2,4-D, MCPB, 2,4-DB, dicamba, and KIL-MOR later than 2 weeks prior to silking and tasseling. Extreme care must be used when applying these herbicides near susceptible crops because of possible herbicide movement. Soybeans, tomatoes and tobacco are extremely sensitive to dicamba and KIL-MOR and injury symptoms may persist for several weeks. DO NOT use dicamba in the area of susceptible crops when temperatures exceed 25° at the time of application. Several rows of corn should be left unsprayed when adjacent to soybean fields or other susceptible crops (see precautions on back cover).

TRIAZINE-RESISTANT BROADLEAF ANNUAL WEEDS

Strains of lamb's-quarters, redroot pigweed and ragweed have been found that are resistant to high rates of all TRIAZINE herbicides including atrazine, cyanazine and simazine. These triazine-resistant species have been found in all corn-growing areas across Ontario. These strains cannot be distinguished from the susceptible strains. Preemergence treatment with dicamba or postemergence treatment with bentazon, bromoxynil, 2,4-D, dicamba, KIL-MOR or directed linuron will usually give control (see appropriate sections above).

NOTES ON ATRAZINE AND SIMAZINE SOIL RESIDUES

Atrazine and simazine residues may last for more than 1 year, particularly if high rates are used more than once and dry weather occurs. Atrazine when used at rates up to 2.25 kg (active) per hectare (**4.5 L of (500 g/L) or 2.5 kg of (90 WP) PRODUCT**) on corn generally has not caused injury on succeeding crops of oats, barley, mixed grains, or soybeans, except in years where there was very little rain the previous fall which would slow down atrazine degradation in the soil. Postemergence treatments may persist longer than preemergence treatments.

Injury has been reported on tomatoes, white beans, forage seedings, peas, tobacco, cucumber, onions, and turnips following applications of atrazine at more than 1.1 kg (active) per hectare (**2.2 L of (500 g/L) or 1.2 kg of (90 WP) PRODUCT**) on corn.

Where crops are to be grown that are extremely sensitive (such as tobacco and vegetable crops) to atrazine use combinations of butylate + or EPTC + with cyanazine as a preplant incorporated treatment or the combination of alachlor or metolachlor + cyanazine as a preemergence treatment.

To reduce the hazard of atrazine residues on succeeding crops:

1. Apply the early postemergence atrazine oil-water treatment with the lower rate of atrazine (1.1 kg (active)) (**2.2 L of (500 g/L) or 1.2 kg of (90 WP) PRODUCT**) per hectare. With this lower rate, a lower measure of weed control may result and cultivations may be necessary.
2. Apply an early postemergence treatment of atrazine using 1.1 kg (active) per hectare (**2.2 of (500 g/L) or 1.2 kg of (90 WP) PRODUCT**) plus 0.55 kg of 2,4-D acid per hectare (**1.1 of AMINE (500 g/L) PRODUCT**). This may also require one shallow cultivation to control weed escapes. 2,4-D is useful in this mixture where perennial weeds such as Canada thistle, sow-thistle, and curled dock are present.
3. Use the combination of alachlor, cyanazine, linuron, or metolachlor with atrazine applied preemergence, or EPTC + or butylate + with atrazine applied preplant incorporated.
4. Fall plowing will speed TRIAZINE breakdown more than will spring plowing.
5. Ensure that the sprayer used is adequate and is properly calibrated and adjusted. Spray uniformly without overlaps and do not spray while the sprayer is stopped.

Atrazine applied as a granular formulation is much more persistent than when applied as a spray. Corn should always be planted the succeeding year when granular atrazine has been used.

Atrazine + simazine has an increased soil residue because of the higher rate of triazines used. This mixture should be used only where corn is to follow corn.

If a residue problem is anticipated contact your local Agricultural Representative for information on soil analysis procedures for triazine residues.

OIL AND SURFACTANTS WITH ATRAZINE OR ATRAZINE/SIMAZINE MIXTURES

Several blends of OIL* and SURFACTANTS in varying proportions are available for use for postemergence application. The rate of application will vary from 10 to 15 L per hectare for the lowest SURFACTANT content (approx. 1%) to 2.5 to 5 L per hectare for the higher SURFACTANT content (approx. 20%) to 0.5 to 1 L per hectare for undiluted SURFACTANTS.

These materials are sold under various trade names. Follow the label directions closely for best results.

In general, OILS (approx. 1% SURFACTANT) have given best results under adverse conditions. These conditions include use on quack grass, nutsedge, and heavy infestations of annual grasses or when weeds have developed under dry or cool conditions and are more difficult to control. Instances of early injury on corn have been reported, especially during cold weather, but it may also occur under other conditions of stress such as hot, dry weather. The corn usually has recovered.

The OIL-SURFACTANT mixtures (approx. 20% SURFACTANT) and the undiluted SURFACTANT should be considered where quack grass, nutsedge or annual grasses are not a serious problem, in an effort to reduce the volume transported when spraying large acreages. Time of application of the oil-surfactant mixtures or undiluted sufactant is the same as with OIL-water. Early corn injury seldom occurs with these two materials, but injury may occur if corn is sprayed when more than 25 cm high (leaf extended).

Do not use 2,4-D, 2,4-DB, dicamba, KIL-MOR, alachlor, metolachlor, or cyanazine in conjunction with OIL-water emulsions or SURFACTANTS. Use only commercial mixtures of OIL or SURFACTANTS.

WEED CONTROL IN ZERO OR LIMITED TILLAGE CORN

Three typical situations exist:

1. Corn following a meadow crop with no plowing.
2. Corn following corn or stubble crop with no plowing.
3. Corn following corn or stubble crop with primary fall tillage only (e.g. heavy-duty cultivator or double-off-set disk).

Atrazine may be applied in situation 1 at any time the previous fall at 4.5 kg (active) per hectare (**9 L of (500 g/L) or 5.0 kg of (90 WP) PRODUCT**), or in situations 2 and 3 at 2.25 kg (active) per hectare (**4.5 L of (500 g/L) or 2.5 kg of (90 WP) PRODUCT**) either in the fall or spring. With certain perennial weed escapes, including alfalfa, the addition of 2,4-D or KIL-MOR should be considered. Alachlor (LASSO) at 2.25 to 2.75 (active) per hectare (**4.75 to 5.75 L PRODUCT**) applied preemergence with atrazine gives excellent control of annual grasses.

Paraquat should be applied in situation 1 along with atrazine at 2.25 to 4.50 kg (active) per hectare (**4.5 to 9 L of (500 g/L) or 2.5 to 5.0 kg of (90 WP) PRODUCT**) in the spring. The addition of paraquat is necessary under these circumstances, but should not be necessary where atrazine at the 4.5 kg (active) per hectare (**9L of (500 g/L) or 5.0 kg of (90 WP) PRODUCT**) rate is applied in the fall. The high rate of 4.5 kg (active) per hectare (**9 L of (500 g/L) or 5.0 kg of (90 WP) PRODUCT**) of atrazine is necessary in the spring to provide control of orchard grass or bromegrass.

The accommodation to zero or limited tillage in corn demands a new approach to weed control. It should also be understood that they are used in conjunction with a zero tillage corn planter.

*Oil should be a light paraffin-based mineral oil having 70-10 S.U.S. viscosity with over 75% unsulfonatable residues and suitably emulsified.

PEANUTS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses, nutsedge and some annual broadleaf weeds.	vernolate VERNAM (720 g/L)	2.24 to 2.5 kg/ha 3.1 to 3.45 L/ha	Apply preplant to a dry soil surface and incorporate immediately (within 10 minutes) after application to a 10 cm depth using a disk (7 — 10 km/hr) or a vibrating shank cultivator (10 — 13 km/hr). A second incorporation at right angles is recommended.
Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and some suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST oil concentrate	0.84 to 1.08 kg/ha 1.75 to 2.25 L/ha plus 2 L/ha	Apply when peanuts are in the unifoliate to 4th trifoliate leaf stage and weeds are small and actively growing. Velvetleaf (15 cm), smartweed (20 cm) and cocklebur (30 cm tall) are controlled. Top growth of nutsedge and Canada thistle are controlled and field bindweed may be suppressed but 2 applications 10 days apart may be required. A new flush of weeds may emerge after the first flush has been controlled. Cool weather or drought may delay control. Reduce rate of oil concentrate to 1 L/ha under abnormally hot, humid or cool weather conditions. Otherwise, temporary crop injury may occur.

SOYBEANS

Note: All treatments should be applied in 150 to 300 L water per hectare unless otherwise specified.

Equipment used to apply DICAMBA (BANVEL), 2,4-D, MCPA, KIL-MOR, or related herbicides should be thoroughly cleaned up immediately after use but before it is used to spray soybeans. See page 22 on "Cleaning the Sprayer".

Total Weed Control System Although herbicides themselves may be effective, there is benefit in using all the various weed control methods available to obtain the best weed control possible. Crop rotation, herbicide rotation, early weed control with a rotary hoe, harrowing, cultivating, and preventing the spread of weeds as much as possible are all a part of weed management. See the corn section for some details of each of these methods.

Triazine Residues Soybeans may follow corn treated with atrazine or simazine the previous year. If triazine residues remain they often interact with a number of the herbicides used for weed control in soybeans to cause crop injury. See notes on triazine residues on page 59.

Specific Weeds For information on specific weeds see Table 4. Then refer to the appropriate section for details about herbicide treatments.

Preplant

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Quack grass	amino triazole/ammonium thiocyanate AMITROL-T, CYTROL (240 g/L)	3.25 kg/ha 13.75 L/ha	Apply to actively growing quack grass (15- 20 cm high) in the fall or spring. Plow or thoroughly disk 10-14 days after application. Cultivation may be required when the crop is emerged.
	glyphosate ROUNDUP (356 g/L)	1.70 to 2.50 kg/ha 4.75 to 7.0 L/ha	Apply in the fall previous to soybeans or in the spring before the crop is planted to actively growing quack grass with at least 4 new leaves per shoot. In fall, remove crop refuse but DO NOT till prior to application. Tillage can occur 5 days after treatment. Rainfall within 6 hours after application may reduce quack grass control. Other herbicides are necessary for annual weed control in the soybean crop.

Preplant Incorporated

Note: Unless specified, apply all treatments in 150 to 300 L of water per hectare. Two incorporations at right angles operating at a depth of 10 cm using a double disk (7-10 km/hour) or vibrating shank S-tine cultivator (10-13 km/hour) are recommended unless otherwise stated. Lower rates are usually for sandy to sandy loam soils, higher rates for clay to clay loam soils.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses, annual nightshade and nutsedge suppression	alachlor LASSO (480 g/L)	3.0 to 4.5 kg/ha 6.0 to 9.5 L/ha	Applied preplant followed by one shallow incorporation (equipment operating at 5 to 10 cm depth). Immediate incorporation is not necessary. Do not apply more than 7 days before planting. Alachlor lasts 8 to 12 weeks in the soil. Broadleaf weeds not controlled by alachlor should be controlled by preemergence application of chloramben, linuron, metribuzin, or monolinuron or a postemergence application of bentazon.
Nutsedge, germinating annual grasses, annual nightshade	metolachlor DUAL (960 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha	Applied preplant followed by one incorporation with a double disk or vibrating shank (S-tine) cultivator operating at a depth of 10 cm. Lasts 10 to 14 weeks in the soil. Effective on most soils except high organic matter, muck or peat soils.

Germinating annual grasses and some control of lamb's quarters and pigweed including triazine-resistant species	trifluralin TREFLAN (545 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha	Applied preplant. Immediate incorporation is recommended; however, delay of incorporation up to 8 hours after application, if necessary, will not likely result in any loss of activity. Effective on mineral soils but poor activity on highly organic soils (muck, peat).
Germinating annual grasses, nutsedge	vernolate VERNAM (720 g/L)	2.25 to 3.25 kg/ha 3.1 to 4.5 L/ha	Applied preplant followed by immediate incorporation (within 10 minutes after application). Ragweed is not controlled. Mustard and ragweed may escape. Lamb's- quarters and pigweed may be controlled. Crop injury may occur which is usually temporary unless adverse weather conditions persist during the growing season.
Nutsedge, germinating annual grasses and broadleaf weeds including nightshade, velvetleaf and cocklebur	metolachlor DUAL (960 g/L) plus metribuzin (tank mix) LEXONE (480 g/L) or SENCOR (500 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 0.42 to 0.56 kg/ha 0.9 to 1.1 L/ha 0.85 to 1.1 L/ha	See metolachlor instructions for incorporation and metribuzin instructions for details.
Germinating annual grasses and broadleaf weeds	trifluralin TREFLAN (545 g/L) plus chloramben (tank-mix) AMIBEN (240 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha plus 2.25 kg/ha 9.25 L/ha	See trifluralin instructions for incorporation and chloramben instructions for necessary details.
Germinating annual grasses and broadleaf weeds	trifluralin TREFLAN (545 g/L) plus metribuzin (tank-mix) LEXONE (75 DF)[1] or SENCOR (500 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha plus 0.42 to 0.56 kg/ha 0.55 to 0.75 kg/ha 0.85 to 1.1 L/ha	See trifluralin instructions for incorporation and other details and metribuzin instructions for details. This tank mix will not control ANNUAL NIGHTSHADE.

[1] *LEXONE (480 g/L) registered rate for this tank mix is 0.85 to 1.5 L/ha.*

Preemergence

Note: Apply all treatments in 150 to 300 L water per hectare. Rainfall at 1.5 to 2 cm/ha within 7 to 10 days after application is necessary to activate preemergence treatments. Shallow cultivation, rotary hoeing or harrowing will control weed escapes and improve herbicide activity in the absence of rainfall.

Lower rates are for sandy soils, higher rates for clay or clay-loam soils and rates intermediate to these for loam soils.

SOYBEANS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses and annual nightshade	alachlor LASSO (480 g/L) LASSO II (15% granular)	2.40 to 3.8 kg/ha 5.0 to 8 L/ha 17.5 to 30 kg/ha	Broadleaf weeds not controlled by alachlor may be controlled by a follow-up postemergence application of bentazon or by tank mixes of herbicides with alachlor (see below). Heavy rainfall and adverse weather conditions may result in temporary crop injury.
Germinating annual broadleaf weeds and annual grasses	chloramben AMIBEN (240 g/L) AMIBEN (10% granular)	2.25 to 3.25 kg/ha 9.25 to 14.0 L/ha 23 to 33 kg/ha	Mustards and cocklebur escape chloramben. Crop safety is excellent. Excessive rainfall may leach out the herbicide. Approximately 6 to 8 weeks control can be expected.
Germinating annual broadleaf weeds and annual grasses	chloramben/linuron AMILON (50WP)	2.25 kg/ha 4.5 kg/ha	A packaged mixture of chloramben with linuron provides a more broad spectrum control of annual weeds than each herbicide alone. See notes for chloramben and linuron concerning details.
Germinating annual broadleaf weeds, some annual grasses	linuron[2] LOROX L (480 g/L) LOROX (50WP) AFOLAN F (450 g/L)	1.1 to 2.25 kg/ha 2.25 to 4.5 L/ha 2.2 to 4.5 kg/ha 2.4 to 5 L/ha	Annual grasses, ragweed and velvetleaf are partially controlled but are the first to escape, particularly if lower rates of the herbicide are used. Do not use on sands (less than 2% organic matter). Seed beans at least 4 cm deep. Heavy rainfall and adverse weather conditions may result in temporary crop injury. Use higher rate for muck soils and clay soils.
Germinating annual broadleaf weeds, some annual grasses	metobromuron PATORAN FW (400 g/L) PATORAN FW (670 g/L)	1.68 to 2.25 kg/ha 4.2 to 5.6 L/ha 2.5 to 3.25 L/ha	See notes for linuron (above) since they apply to metobromuron. Weed control in muck soils requires a 50% increase in the rate of metobromuron to provide acceptable weed control.
Germinating annual grasses and annual nightshade	metolachlor DUAL (960 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha	Lasts 10 to 14 weeks in the soil. Effective on a wide range of soil types. Do not use on muck, peat or high organic matter soils. To control broadleaf weeds escaping metolachlor tank mix with broadleaf weed herbicides (see below).
Germinating annual broadleaf weeds, some grasses	monolinuron AFESIN (200 g/L)	1.7 to 1.95 kg/ha 8.5 to 9.75 L/ha	Do not use on sandy soils (3% organic matter or less). Beans should be seeded at least 4 cm deep. Annual grasses, ragweed, and velvetleaf are partially controlled but are the first weeds to escape, particularly at lower herbicide rates. Heavy rainfall and adverse weather conditions may result in crop injury which is usually of a temporary nature.

Germinating annual broadleaf weeds and annual grasses including velvetleaf, but not nightshade	metribuzin[3] LEXONE (75 DF) SENCOR (500 g/L)	0.42 to 1.12 kg/ha 0.56 to 1.50 kg/ha 0.85 to 2.25 L/ha	Do not use on sandy soils (2% organic matter or less). Annual nightshade is not controlled. Velvetleaf, cocklebur and jimsonweed control is usually satisfactory. Use the recommended rate for each soil type (see label) otherwise crop injury may occur. Excessive rainfall and adverse weather conditions may result in crop injury.
Germinating annual broadleaf weeds, annual grasses and annual nightshade	alachlor LASSO (480 g/L) plus chloramben AMIBEN (240 g/L)	1.75 to 2.25 kg/ha 3.65 to 4.7 L/ha plus 1.75 to 2.25 kg/ha 7.5 to 9.25 L/ha	See alachlor and chloramben instructions for details.
	alachlor LASSO (480 g/L) plus linuron[4] AFOLAN (450 g/L) or LOROX (50WP)	2.4 to 3.4 kg/ha 5 to 7 L/ha plus 0.85 to 1.1 kg/ha 1.9 to 2.5 L/ha 1.8 to 2.2 kg/ha	See alachlor and linuron instructions for details.
	alachlor LASSO (480 g/L) plus metribuzin[5] LEXONE (75 DF) or SENCOR (500 g/L)	2.4 to 2.6 kg/ha 5 to 5.5 L/ha plus 0.42 to 0.75 kg/ha 0.56 to 1.0 kg/ha 0.85 to 1.5 L/ha	See alachlor and metribuzin instructions for details.
Germinating annual broadleaf weeds, annual grasses and annual nightshade	metolachlor DUAL (960 g/L) plus chloramben AMIBEN (240 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 1.68 to 2.22 kg/ha 7.0 to 9.25 L/ha	See metolachlor and chloramben instructions for details.
	metolachlor DUAL (960 g/L) plus linuron[6] AFOLAN F (450 g/L) or LOROX (50WP)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 0.85 to 1.1 kg/ha 1.9 to 2.5 L/ha or 1.75 to 2.25 kg/ha	See metolachlor and linuron instructions for details.
	metolachlor DUAL (960 g/L) plus metobromuron PATORAN (400 g/L) or PATORAN (670 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 1.2 to 1.70 kg/ha 2.75 to 4.4 L/ha or 1.75 to 2.5 L/ha	See metolachlor and metobromuron for details.
	metolachlor DUAL (960 g/L) plus metribuzin[7] LEXONE (480 g/L) or SENCOR (500 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 0.42 to 0.75 kg/ha 0.9 to 1.6 L/ha or 0.85 to 1.5 L/ha	See metolachlor and metribuzin for details.

SOYBEANS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	metolachlor DUAL (960 g/L) plus monolinuron AFESIN (200 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha plus 1.1 to 1.7 kg/ha 5.5 to 8.5 L/ha	See metolachlor and monolinuron for details.

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[2] *AFOLAN EC (190 g/L) equivalent is 5.8 to 11.85 L/ha. AFOLAN F (450 g/L) equivalent is 2.45 to 5 L/ha for a 1.1 to 2.25 kg active/ha rate.*

[3] *LEXONE (480 g/L) equivalent label rate is 0.9 to 2.3 L/ha. SENCOR (50 WP) equivalent rate is 0.85 to 2.25 kg/ha.*

[4] *LOROX (480 g/L) equivalent rate is 1.8 to 2.25 L/ha. AFOLAN (190 g/L) equivalent rate is 4.5 to 5.8 L/ha.*

[5] *LEXONE (480 g/L) equivalent rate is 0.9 to 1.6 L/ha. SENCOR (50 WP) equivalent is 0.85 to 1.5 kg/ha.*

[6] *AFOLAN EC (190 g/L) equivalent rate is 4.5 to 5.8 L/ha. LOROX (480 g/L) equivalent rate is 1.8 to 2.3 L/ha.*

[7] *SENCOR (50WP) equivalent rate is 0.85 to 1.7 kg/ha.*

Postemergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and some suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST OIL CONCENTRATE	0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha plus 2 L/ha	Apply when soybeans are in unifoliate to 4th trifoliate leaf stage and weeds are small and actively growing. Velvetleaf (15 cm), smartweed (20 cm) and cocklebur (30 cm tall) are controlled. Top growth of Canada thistle, yellow nutsedge and field bindweed is controlled but 2 applications 10 days apart may be required. A new flush of weeds may emerge after the first flush has been controlled. Temporary crop injury may occur under abnormally cool or hot humid conditions. Reduce rate of oil concentrate to 1 L/ha when those conditions occur. Cool weather or drought may delay control.
Emerged annual grasses including green and yellow foxtail, barnyard grass, old witchgrass, fall panicum, wild oats, and volunteer corn but not crabgrass	diclofop-methyl HOE-GRASS (190 g/L)	1.0 kg/ha 5.25 L/ha	Apply when annual grasses are in the 1- to 4-leaf stage (2- to 3-leaf stage is optimum). Do not mix with other postemergence herbicides because diclofop-methyl is inactivated. Other postemergence herbicides must be applied at least 4 days before or after diclofop-methyl application.

Emerged velvetleaf and smartweed	chloramben AMIBEN (240 g/L)	2.67 to 3.25 kg/ha 11.5 to 14.0 L/ha	Apply when soybeans are at the cracking to second trifoliate leaf stage. Use high rate on fine-textured soils or when heavy weed infestations are encountered. Velvetleaf and smartweed are controlled or suppressed when chloramben is applied when weeds are 2 to 10 cm tall. Chloramben will also control most annual weeds preemergently. Best control may be achieved by removing emerged weeds by cultivation. If a preplant incorporated or preemergence application of chloramben has already been made, do not re-treat postemergence. Do not feed straw or green fodder-treated postemergence with chloramben.
Emerged annual grasses, wild proso millet, volunteer corn and volunteer cereals	sethoxydim POAST (184 g/L) plus ASSIST oil concentrate	0.15 to 0.35 kg/ha 0.8 to 1.9 L/ha 2 L/ha	SETHOXYDIM should be applied to emerged, actively growing annual grasses in the 1 to 6 leaf stage (10-15 cm height). Prolonged drought, cold, or excessive moisture (flooding) conditions, rainfall within one hour of application, as well as application of other chemicals or cultivation within 4 days of SETHOXYDIM treatment may reduce its effectiveness. A second application and/or cultivation (in wide rows) may be necessary to control grasses that emerge after treatment. Complete control is normally within 7 to 21 days following SETHOXYDIM application. ASSIST oil concentrate should always be added at 2 L/ha. Soybeans are tolerant to SETHOXYDIM at all stages of growth.

HARVEST-AID

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Harvest-aid to burn off weeds	diquat plus surfactant REGLONE (200 g/L) plus Agral 90	0.42 to 0.55 kg/ha 2 to 2.75 L/ha 1 L per 1000 L spray solution	Apply in 300 L/ha water to burn off weeds when 80 to 90% natural crop leaf defoliation has occurred. Beware of drift to adjacent crops or plants.

Spot Treatment

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Spot treatment control of emerged Canada thistle and quack grass	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.5 to 7 L/ha	Apply as a spot treatment when quack grass has more than 4 leaves per stem and milkweed, bindweed, or thistles are at bud to flower stage. The crop will be killed in the sprayed area. Rainfall should not occur within 6 hours of application or weed control will be reduced.
Spot treatment control of milkweed and field bindweed	glyphosate ROUNDUP	2.5 to 4.25 kg/ha 7 to 12 L/ha	

Split Application

Preplant incorporated herbicide treatments followed by preemergence or postemergence treatments offer many split applications or sequential combinations or programs. Similarly preemergence treatments may be followed by postemergence herbicides for broad spectrum weed control. The combination of a herbicide whose strength is controlling annual grasses with a herbicide whose strength is mainly broadleaf weed control is recommended. Three-quarters of the full rate to the full rate of each partner is recommended depending on soil type and weed infestation.

Herbicides Controlling Most Annual Grasses	Applied	Herbicides Controlling Most Annual Broadleaf Weeds	Applied
trifluralin (TREFLAN)	ppi	linuron (AFOLAN, LOROX)	pre
alachlor (LASSO)	ppi or pre	metobromuron (PATORAN)	pre
metolachlor (DUAL)	ppi or pre	monolinuron (AFESIN)	pre
diclofop-methyl (HOEGRASS)	post	chloramben (AMIBEN)	pre
vernolate (VERNAM)	ppi	metribuzin (LEXONE, SENCOR)	pre
		bentazon (BASAGRAN)	post

For sequential or split applications use one herbicide from the left-hand column for annual grass control and combine or program it with one of the herbicides from the right-hand column for annual broadleaf control. Do not tank-mix any of the products or formulations that are not registered in combination.

TABLE 4. SOYBEAN HERBICIDE WEED CONTROL RATINGS

For complete information refer to pages 61 to 70. The chemical ratings in this chart give general comparisons based on use as described in this guide. Under favorable conditions (e.g. too dry, too wet, too cold, or poor application) the herbicides may not be as effective as indicated.

Rating
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Method[1] of Application	ANNUAL BROADLEAVES								ANNUAL GRASSES					PERENNIALS							CROP TOLERANCE
			buckwheat, wild	lady's-thumb	lamb's-quarters	mustards	nightshades, annual	pigweeds	ragweed	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	
amitrole T	Amitrol-T, Cytrol	preplant	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	G	*	*	G
glyphosate	Roundup	preplant	*	*	*	*	*	*	*	*	*	*	*	*	*	[2]	*	*	[2]	E	[2]	[2]	G
glyphosate	Roundup	spot treat or	*	*	*	*	*	*	*	*	*	*	*	*	*	E	P	E	G	E	E	E	P
		after harvest	*	*	*	*	*	*	*	*	*	*	*	*	*	P	*	*	E	*	*	G	P
alachlor	Lasso	ppi	P	P	F	P	G	P	P	P	G	E	E	E	E	P	P	P	F	P	P	P	G
metolachlor	Dual	ppi	P	P	P	P	G	P	P	P	E	E	G	E	E	P	P	P	G	P	P	P	G
trifluralin	Treflan	ppi	F	F	G	P	P	G	P	P	E	E	G	E	E	P	P	P	P	P	P	P	G
metolachlor + metribuzin	Dual plus Lexone or Sencor	ppi	G	E	E	E	G	E	E	E	E	E	G	E	E	P	P	P	G	P	P	P	G
trifluralin + chloramben	Treflan + Amiben	ppi	E	E	E	P	F	E	G	F	E	E	G	E	E	P	P	P	P	P	P	P	G
trifluralin + metribuzin	Treflan + Sencor or Lexone	ppi	E	E	E	E	P	E	G	E	E	E	G	E	E	P	P	P	F	P	P	F	G
vernolate	Vernam	ppi	F	F	F	P	P	F	F	P	G	E	G	E	G	P	F	P	F	P	P	P	G
alachlor	Lasso	pre	P	P	F	P	G	P	P	P	G	E	E	E	E	P	P	P	P	P	P	P	G
chloramben	Amiben	pre	E	E	E	P	F	E	G	F	G	G	F	G	G	P	P	P	P	P	P	P	E
chloramben/linuron	Amilon	pre	E	E	E	G	F	E	G	F	G	G	F	G	G	P	P	P	P	P	P	P	E
linuron	Afolan, Lorox	pre	E	E	E	E	G	E	G	F	F	F	F	F	F	P	P	P	P	P	P	P	G
monolinuron	Afesin	pre	E	E	E	E	G	E	G	F	F	F	F	F	F	P	P	P	P	P	P	P	G
metobromuron	Patoran	pre	E	E	E	E	G	E	G	F	F	F	F	F	P	P	P	P	P	P	P	P	G
metribuzin	Lexone, Sencor	pre	G	E	E	E	P	E	E	E	G	G	G	G	G	P	P	P	P	P	P	P	G
metolachlor	Dual	pre	P	P	P	P	G	P	P	P	E	E	G	E	E	P	P	P	P	P	P	P	G
alachlor plus one of (Tank mix)[3] treatments below	Lasso	pre																					
chloramben	Amiben	pre	E	E	E	P	G	E	G	F	E	E	E	E	E	P	P	P	P	P	P	P	G
linuron	Lorox	pre	E	E	E	E	G	E	G	F	G	E	E	E	E	P	P	P	P	P	P	P	G
metribuzin	Lexone, Sencor	pre	G	E	E	E	G	E	E	E	E	E	E	E	E	P	P	P	P	P	P	P	G

TABLE 4. SOYBEAN HERBICIDE WEED CONTROL RATINGS (Cont'd)

metolachlor plus one of (Tank mix) 5 treatments below	Dual	pre																				
chloramben	Amiben	pre	E	E	E	P	G	E	G	F	E	E	G	E	E	P	P	P	P	P	P	P	G
linuron	Afalon, Lorox	pre	E	E	E	E	G	E	G	F	E	E	G	E	E	P	P	P	P	P	P	P	G
metobromuron	Patoran	pre	E	E	E	E	G	E	G	F	E	E	G	E	E	P	P	P	P	P	P	P	G
metribuzin	Lexone, Sencor	pre	G	E	E	E	G	E	E	E	E	E	G	E	E	P	P	P	P	P	P	P	G
monolinuron	Afesin	pre	E	E	E	E	G	E	G	F	E	E	G	E	E	P	P	P	P	P	P	P	G
bentazon	Basagran	post	F	E	G	E	F	G	E	E	P	P	P	P	P	[1]G	P	P	[1]G	P	[1]G	[1]G	G
diclofop-methyl	Hoe-Grass	post	P	P	P	P	P	P	P	P	E	F	E	E	E	P	P	P	P	P	P	P	E

** Indicates the annual weeds will be controlled if emerged, and the perennials can be controlled if treated at the optimum time which is usually not the same time as for quack grass.*

[1] Good control of these perennial weeds may require two applications of BENTAZON + ASSIST oil concentrate about 7 to 10 days apart.

[2] Optimum growth stages for best control of these weeds will not likely be attained prior to planting soybeans. See further details on label.

BEANS (WHITE, SNAP and KIDNEY)

Note: All treatments should be applied in 150 to 300 L water per hectare unless otherwise specified.

Registered rates for metobromuron and amino triazole/ammonium thiocyanate differ between manufacturers. For further information on these and other chemicals refer to label recommendations and also the Notes on Chemicals section of this publication.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Preplant			
Quack grass	amino triazole/ ammonium thiocyanate AMITROL-T, CYTROL (240 g/L)	3.25 kg/ha 13.5 L/ha	Apply in fall or spring to actively growing quack grass foliage (15-20 cm high). Wait 10 to 14 days before plowing or disking. Not registered for use on snap beans or kidney beans. Row cultivation may be required for satisfactory control.
Preplant Incorporated			
Germinating annual grasses, annual nightshades and nutsedge suppression	alachlor LASSO (480 g/L)	2.4 to 3.4 kg/ha 5.0 to 7.0 L/ha	(White beans and kidney beans only) Alachlor must be preplant incorporated. Do not apply to very sandy soils. If cold wet soil conditions occur after planting, delayed growth and maturity and/or reduced yields may occur from alachlor. Annual grasses and annual nightshades are controlled and early

			nutsedge suppression can be expected. Many annual broadleaf weeds escaping alachlor may be controlled by following up with metobromuron or monolinuron applied preemergence or bentazon applied postemergence.
Germinating annual grasses, nutsedge	EPTC EPTAM (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	EPTC should be applied to a dry soil surface before planting, and incorporated within 10 minutes. If dry weather has preceded the application of EPTC, delay seeding 7 to 10 days. Application to a moist soil surface has been ineffective. Temporary injury can occur in the emerging crop. Common annual broadleaf weeds may escape but can be controlled by the preemergence application of metobromuron or monolinuron or a postemergence application of bentazon.
Germinating annual grasses, nutsedge, annual nightshades	metolachlor DUAL (960 g/L)	1.68 to 2.64 kg/ha 1.75 to 2.75 L/ha	Metolachlor must be preplant incorporated before seeding the crop. Set tillage equipment such as tandem disks or S-tine cultivators to a depth of 10 cm and thoroughly incorporate in one direction. Immediate incorporation is not necessary. This herbicide lasts 10 to 14 weeks in the soil. It is effective over a wide range of soil types but should not be applied to muck, peat muck or high organic matter soils. Perennial weeds other than nutsedge, are not controlled. Metobromuron or monolinuron applied preemergence or bentazon postemergence will control annual broadleaf weeds which may escape metolachlor. Metolachlor is not registered for use on snap beans or kidney beans.
Germinating annual grasses	trifluralin TREFLAN (545 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha	Trifluralin must be applied before planting and incorporated into the soil. Incorporation should be done as soon as possible but within 8 hours in 2 directions. Use the higher rate on clay soil and the lower rate on sand. Ragweed, American nightshade, nutsedge, velvetleaf and mustard are not controlled and lady's-thumb may escape. The use of metobromuron or monolinuron preemergence or the postemergence application of bentazon will control the weeds that usually escape the trifluralin treatment.

Preemergence

Germinating common annual broadleaf weeds and grasses	chloramben AMIBEN (240 g/L) or AMIBEN (10% GR)* *Apply granular formulation as a dry product.	2.25 to 3.25 kg/ha 9.4 to 13.5 L/ha 22.5 kg/ha	**Use the lower rate for sandy soil and the higher rate for clay soil.** Chloramben controls most annual broadleaf weeds and grasses with the exception of mustards for at least 8 weeks after application. Delayed maturity of field beans may occur if heavy rainfall follows application of this chemical. When dry weather follows application, a shallow cultivation, harrowing or rotary hoeing may be used to improve weed control. This also assists in breaking a soil crust without reducing the chemical action of chloramben. The granular formulation is not registered for use on white or kidney beans.

BEANS (WHITE, SNAP and KIDNEY) Cont'd

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating common annual broadleaf weeds**	metobromuron PATORAN FL (400 g/L) or PATORAN FL (670 g/L)	1.17 to 1.68 kg/ha 2.9 to 4.25 L/ha 2.0 to 2.5 L/ha	Do not exceed 1.17 kg/ha (active) for kidney beans or snap beans. Metobromuron controls annual broadleaf weeds. Annual grasses may be partially controlled but are the first to escape, and rotary hoeing or cultivation may be necessary to give complete weed control. Use the lower rate on sandy soils, but do not use on sandy soils of less than 3% organic matter. Beans should be seeded at least 5 cm deep. Injury may occur if beans are under stress. Beans in the early stages of growth may also be injured from treated soil having been splashed up onto the leaves by a rainstorm. A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash-up as well as help activate the chemical if dry weather follows application.
	monolinuron AFESIN (200 g/L)	1.1 to 1.4 kg/ha 5.5 to 7.0 L/ha	Monolinuron controls annual broadleaf weeds and some annual grasses. Use the low rate for sandy loam soils but do not apply to coarse sandy soils low in organic matter (less than 3%). Beans should be seeded at least 5 cm deep. Shallow planted crops may be injured if heavy rains follow application. A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash-up as well as help activate the chemical if dry weather follows application.

***Common annual broadleaf weeds include ragweed, pigweed, lamb's-quarters, and mustards (see exceptions under Remarks).*

Postemergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and some suppression of field bindweed.	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha 1 L/ha	Use 200 to 400 litres of water per hectare. Apply when beans are in unifoliate to 4th trifoliate leaf stage and weeds are small and actively growing. Velvetleaf (15 cm) smartweed (20 cm) and cocklebur (30 cm) are controlled. Top growth of Canada thistle, yellow nutsedge and field bindweed is controlled but 2 applications 10 days apart may be required. A new flush of weeds may emerge after the first flush has been controlled. Temporary crop injury may occur under hot, humid conditions. Cool weather or drought may delay control.

Green and yellow foxtail, barnyard grass, old witch grass, wild oats, fall panicum and volunteer corn.	diclofop-methyl HOE-GRASS (190 g/L)	1.0 kg/ha 5.3 L/ha	Diclofop-methyl should be applied postemergence to annual grasses and volunteer corn in the 1- to 4-leaf stage (optimum control at the 2- to 3-leaf stage approximately 10 to 16 days after emergence). Do not apply if rain is expected within one hour after application. Other herbicides should not be tank mixed with diclofop-methyl. Other postemergence herbicides should be applied 4 days before or after diclofop-methyl application. Annual broadleaf weeds must be controlled with other herbicides.

Split Application

Annual nightshade, other germinating annual broadleaf weeds and annual grasses, nutsedge suppression	alachlor LASSO (480 g/L)	2.4 to 3.4 kg/ha 5.0 to 7.0 L/ha	See remarks on alachlor in preplant incorporated section.
	followed by metobromuron	1.17 to 1.34 kg/ha	See remarks on metobromuron in preemergence section.
	PATORAN FL (400 g/L)	2.9 to 3.4 L/ha	
	or PATORAN FL (670 g/L)	1.75 to 2.0 L/ha	
	or by monolinuron	1.1 to 1.4 kg/ha	See remarks on monolinuron in preemergence section.
	AFESIN (200 g/L)	5.5 to 7.0 L/ha	
	or by bentazon plus oil concentrate	0.85 to 1.1 kg/ha	See remarks on bentazon in the postemergence section.
	BASAGRAN (480 g/L) plus ASSIST	1.75 to 2.25 L/ha 1 L/ha	
Germinating annual broadleaf weeds and grasses, nutsedge.	EPTC EPTAM (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	See remarks on EPTC in preplant incorporated section.
	followed by metobromuron	1.17 to 1.34 kg/ha	See remarks on metobromuron and monolinuron in the preemergence section.
	PATORAN FL (400 g/L) or PATORAN FL (670 g/L)	2.9 to 3.4 L/ha 1.75 to 2.0 L/ha	
	or by monolinuron	1.1 to 1.4 kg/ha	
	AFESIN (200 g/L)	5.5 to 7.0 L/ha	

BEANS (WHITE, SNAP and KIDNEY) Cont'd

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	or by bentazon plus oil concentrate	0.85 to 1.1 kg/ha	See remarks on bentazon in the postemergence section.
	BASAGRAN (480 g/L) plus ASSIST	1.75 to 2.25 L/ha 1 L/ha	
Germinating annual broadleaf weeds and grasses, nutsedge, annual nightshade	metolachlor	1.7 to 2.6 kg/ha	See remarks on metolachlor in the preplant incorporated section.
	DUAL	1.75 to 2.75 L/ha	
	followed by metobromuron	1.17 to 1.34 kg/ha	
	PATORAN FL (400 g/L) or	2.9 to 3.4 L/ha	See remarks on metobromuron and monolinuron in the preemergence section.
	PATORAN FL (670 g/L)	1.75 to 2.0 L/ha	
	or by monolinuron	1.1 to 1.4 kg/ha	
	AFESIN (200 g/L)	5.5 to 7.0 L/ha	
	or by bentazon plus oil concentrate	0.85 to 1.1 kg/ha	See remarks on bentazon in the postemergence section.
	BASAGRAN (480 g/L) plus ASSIST	1.75 to 2.25 L/ha 1 L/ha	
	trifluralin	0.6 to 1.1 kg/ha	See remarks on trifluralin in the preplant incorporated section.
	TREFLAN (545 g/L)	1.1 to 2.1 L/ha	
	followed by bentazon plus oil concentrate	0.85 to 1.1 kg/ha	See remarks on bentazon in the postemergence section.
	BASAGRAN (480 g/L) plus ASSIST	1.75 to 2.25 L/ha 1 L/ha	
Germinating annual broadleaf weeds and annual grasses	trifluralin	0.6 to 1.1 kg/ha	See remarks on trifluralin in the preplant incorporated section.
	TREFLAN (545 g/L)	1.1 to 2.1 L/ha	
	followed by metobromuron	1.17 to 1.34 kg/ha	See remarks on metobromuron and monolinuron in the preemergence section.

	PATORAN FL (400 g/L) or	2.9 to 3.4 L/ha	
	PATORAN FL (670 g/L)	1.75 to 2.0 L/ha	
	or by monolinuron AFESIN (200 g/L)	1.1 to 1.4 kg/ha 5.5 to 7.0 L/ha	

HARVEST AID

Harvest-Aid to burn off weeds	diquat REGLONE (200 g/L) plus surfactant AGRAL 90	0.42 to 0.55 kg/ha 2.1 to 2.75 L/ha 1 L/1000 L	Diquat should be used to burn off weeds at 0.42 kg (active) per hectare (2.1 L product) where the weed infestation is light to moderate and at 0.55 kg (active) per hectare (2.75 L product) where weed infestation is moderate to heavy. Use 300 L/ha of water. Spray when 80 to 90% of the leaves have dropped from the bean plants. Add AGRAL 90 (a wetting and spreading agent) at a rate of 1 L/1000 L of spray mixture to provide a more uniform coverage. Weeds should be burned off in a week or less. **The treatment does not mature beans nor does it lower moisture content of beans.** Pulling and combining beans may be done at any time. **Not registered for use on snap beans.**

METRIC EQUIVALENTS
1 kilogram per hectare (kg/ha) = 0.89 pounds per acre
1 litre per hectare (L/ha) = 0.7 pints per acre
SEE PAGE 150 and inside back cover FOR OTHER METRIC EQUIVALENTS

TABLE 5. WHITE, SNAP OR KIDNEY BEAN HERBICIDE WEED CONTROL RATINGS

Weed Control Rating and Crop Tolerance
E — Excellent
G — Good
F — Fair
P — Poor

Treatment	Trade Name	Method† of Application	ANNUAL BROADLEAVES								ANNUAL GRASSES						PERENNIALS							BEAN TOLERANCE
			buckwheat, wild	lady's-thumb	lamb's-quarters	mustards	nightshades, annual	pigweeds	ragweeds	velvetleaf	barnyard grass	crabgrass	fall panicum	foxtails	old witch grass	proso millet	bindweed, field	horsetail	milkweed	nutsedge	quackgrass	sow-thistle	thistle; Canada	
amitrole**	AMITROLE-T, CYTROL	preplant	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	G	E	G	G
alachlor	LASSO	ppi	P	P	P	P	G	P	P	P	E	E	G	E	E	F	P	P	P	F	P	P	P	G
EPTC	EPTAM	ppi	F	F	G	P	F	F	F	F	E	E	E	E	E	F	P	F	P	G	F	P	P	E
metolachlor	DUAL	ppi	P	P	P	P	G	P	P	P	E	E	G	E	E	F	P	P	P	G	P	P	P	G
trifluralin	TREFLAN	ppi	P	P	G	P	P	G	P	P	E	E	G	E	E	F	P	P	P	P	P	P	P	E
chloramben	AMIBEN	pre	G	G	G	F	F	E	G	F	G	F	P	F	G	P	P	P	P	P	P	P	P	E
metobromuron	PATORAN	pre	E	E	E	E	G	E	E	F	F	F	F	F	G	P	P	P	P	P	P	P	P	G
monolinuron	AFESIN	pre	E	E	E	E	G	E	E	F	F	F	-	F	G	P	P	P	P	P	P	P	P	G
bentazon	BASAGRAN	post	F	E	G	E	G	G	E	E	P	P	P	P	P	P	'G	P	P	'G	P	'G	'G	G
diclofop-methyl	HOE-GRASS	post	P	P	P	P	P	P	P	P	E	F	E	E	E	P	P	P	P	P	P	P	P	E
alachlor	LASSO	ppi																						
followed by one of three treatments below																								
metobromuron	PATORAN	pre	E	E	E	E	G	E	G	F	E	E	E	E	E	F	P	P	P	F	P	P	P	G
monolinuron	AFESIN	pre	E	E	E	E	G	E	E	F	E	E	G	E	E	F	P	P	P	F	P	P	P	G
bentazon	BASAGRAN	post	F	E	E	E	G	E	E	E	E	E	G	E	E	F	'G	P	P	'G	P	'G	'G	G
EPTC	EPTAM	ppi																						
followed by one of three treatments below																								
metobromuron	PATORAN	pre	E	E	E	E	G	E	E	F	E	E	G	E	E	F	P	P	P	G	F	P	P	G
monolinuron	AFESIN	pre	E	E	E	E	G	E	E	F	E	E	G	E	E	F	P	P	P	G	F	P	P	G
bentazon	BASAGRAN	post	F	E	G	E	G	G	E	E	E	E	G	E	E	F	'G	P	P	G	F	'G	'G	G
metolachlor	DUAL	ppi																						
followed by one of three treatments below																								
metobromuron	PATORAN	pre	E	E	E	E	G	E	G	F	E	E	G	E	E	F	P	P	P	G	P	P	P	G
monolinuron	AFESIN	pre	E	E	E	E	G	E	E	F	E	E	G	E	E	F	P	P	P	G	P	P	P	G
bentazon	BASAGRAN	post	F	E	E	E	G	E	E	E	E	E	G	E	E	F	'G	P	P	'G	P	'G	'G	G
trifluralin	TREFLAN	ppi																						
followed by one of three treatments below																								
metobromuron	PATORAN	pre	E	E	E	E	G	E	G	F	E	E	G	E	E	F	P	P	P	P	P	P	P	G
monolinuron	AFESIN	pre	E	E	E	E	G	E	G	F	E	E	G	E	E	F	P	P	P	P	P	P	P	G
bentazon	BASAGRAN	post	F	E	G	E	G	G	E	E	E	E	G	E	E	F	'G	P	P	'G	P	'G	'G	G

† ppi preplant incorporated, pre-preemergence, post-postemergence

* *Amitrole cannot be used effectively to control these weeds in the white bean crop, but it may be used to control all weeds after harvest. Sow-thistle and Canada thistle will be controlled if emerged at the time of spraying.*

***Amitrole cannot be used on snap or kidney beans as it is not registered.*

[1] *Good control of these perennial weeds may require two applications of BENTAZON + ASSIST OIL CONCENTRATE about 7 to 10 days apart.*

TOBACCO (FLUE-CURED and BURLEY)

Apply in 150 to 300 L water per hectare.

WEEDS	**Generic Name TRADE NAME & (Formulation)**	**Rate (Active) RATE (PRODUCT)**	**REMARKS**
Germinating annual weeds	diphenamid ENIDE 50WP	6.75 kg/ha 13.5 kg/ha	Apply in a 25 cm band over the row immediately after transplanting. Since diphenamid may persist in the fall and injure a fall-planted cereal crop, it is important to apply in a band and then after harvest work the soil at right angles to the tobacco row. Registered for flue-cured tobacco only.
Germinating annual weeds and horsetail	pebulate TILLAM (720 g/L)	4.5 to 5.5 kg/ha 6.3 to 7.7 kg/ha	Pebulate should be applied to a dry soil surface and incorporated within 10 minutes. Delay transplanting for 4 days after application. Use the low rate on sandy soils and high rate on loamy sands. It can also be applied at the higher rate prior to row fumigation.

METRIC EQUIVALENTS
1 kilogram per hectare (kg/ha) = 0.89 pounds per acre
1 litre per hectare (L/ha) = 0.7 pints per acre
SEE PAGE 150 FOR OTHER METRIC EQUIVALENTS

HORTICULTURAL CROPS

Many horticultural crops are damaged by some of our common herbicides. Sprayers that have been used for hormone-type (2,4-D etc.) chemicals SHOULD NOT BE USED for applying insecticides, fungicides, or herbicides on susceptible horticultural crops.

The treatments listed in this publication are based on extensive field trials and observations on farms. **Herbicides should not be used in cold frames or greenhouses unless specifically recommended.**

The higher value per hectare of most horticultural crops compared with field crops sometimes justifies the use of more expensive chemicals. Their correct use should result in savings in cultivation, hand weeding, and other costs. Sometimes weeds escape a chemical treatment and cultivation is necessary. Such weeds should be considered an escape when they reach the 3- to 4-leaf stage.

It is difficult to control quack grass, field bindweed, horsetail and similar perennial weeds in crops such as asparagus, strawberries, raspberries, etc. which occupy the same area for a period of years. Perennial weeds of this type should be eradicated or brought under control before these crops are planted. (See pages 142 and 143.)

The recommendations for some of the horticultural crops, such as snap beans, peas, and sweet corn will be found in the field crops section because they are similar to those for field beans, peas, and field corn. Differences have been noted where necessary.

WEED CONTROL IN GARDENS

Many garden plants can be killed or damaged by the chemicals used to kill weeds. The frequent use of a hoe, or other shallow cultivation, is the most practical method of controlling weeds in gardens. Most annual weeds can be killed with one or two cultivations. Perennial weeds can be killed by any kind of cultivation which removes all top growth at frequent intervals. After the food stored in the roots has been used, the weeds will die.

When it is possible to apply the chemical to one kind of garden plant, without danger of spray or dust drifting onto susceptible garden plants, one of the chemicals recommended in this publication may be used. (Check list below.) Granular formulations can be applied using a jam jar with a perforated top. This "salt shaker" method, after a little practice, is effective and quick. A small compressed air sprayer can be used to apply any liquid or wettable powder which is mixed in water. It is important that the correct amount be applied. One way of ensuring accuracy is to fill the garden sprayer with water to a mark — apply the spray of water to 100 m^2 taking care to apply it as evenly as possible, and then measure the amount of water used. Add the chemical recommended in the publication to this amount of water for each 100 m^2 treated.

As a guide in converting the recommended rate of any chemical to the amount required for a small area, 32 g per 100 m^2 is approximately equal to 3.25 kg per hectare. For liquid measure, 2 level tbsp is approximately 28 mL. One L of spray mixture per 100 m^2 is equal to 100 L per hectare.

The herbicides listed under each crop are available for farm, custom spraying, and industrial use. **The Ontario Pesticides Act 1973 restricts the sale of herbicides to the home gardener to those with a domestic label**. These are:

Generic Name	Example of Product
ammonium sulfamate	— Poison-Ivy and Brush Killer, Brush Killer A
amitrol	— Backyard clean-up
amitrol-simazine mixture	— Vegetation Killer, Steril Liquid
chloramben	— Garden Weeder. Ornamental Weeder, Weed Preventer, No-Hoe
chlorthal dimethyl	— Dacthal
dalapon	— Quack Grass Killer
EPTC	— Eptam, Weed Preventer
2,4-D + mecoprop	— Premium Spot Weed Killer
paraquat/diquat mixtures	— Soluble granules
chlorate/borate mixtures	— TOTAL Vegetation Control, Steril Granular
trifluralin	— Fertilizer mixtures, Weed Preventer, Weed-Stop
various crabgrass control chemicals	— Betasan, Dacthal, trifluralin/fertilizer mixtures and Crabgrass Preventer
2,4-D	— Lawn Weed Killer, fertilizer mixtures

WEED CONTROL IN VEGETABLE CROPS

Contact Herbicides

These materials kill all aboveground foliage on contact. Contact herbicides can be used in a stale seedbed technique. The seedbed is prepared early to allow a delay of seeding for several weeks. After the weeds have emerged, but before the crop has emerged, paraquat or diquat (3 to 5.5 L (product) in 250 to 1000 L per hectare) is applied. The soil should be disturbed as little as possible after treatment or a new crop of weeds will appear. These herbicides are registered for this use on beans, beets, carrots, cole crops, onions, peas, potatoes, sweet corn, and rutabagas.

Inter-row weeding with a contact herbicide such as paraquat (3 to 5.5 L (Product) in 250 to 1000 L per hectare) can be used as a rescue operation where other methods of weed control have failed. The herbicide is directed between the crop rows onto the emerged weeds. Use special low-pressure (7 to 15 kPa) applicators such as dribble bars or vibra jets equipped with shields to prevent wetting the crop. This technique of weeding with paraquat is registered for use in beans, beets, carrots, cole crops, cucumbers, lettuce, onions, potatoes, sweet corn, and tomatoes.

Pre-Planting Treatments

Pre-planting treatments are applied before the crop is sown or planted. Some of these herbicides kill seedlings soon after germination while others also kill weed seeds. Most herbicides used for these treatments must be thoroughly incorporated in the soil by cultivation soon after application. Check the label.

Selective Preemergence Herbicides

These mateials prevent emergence of many weed seedlings without reducing crop stand. This type of material should be applied immediately after seeding or at least before emergence of the crop. If these materials are applied after weeds have emerged, kill is usually poor. Best results are obtained with this method of use when conditions for weed-seed germination are good.

Selective Postemergence Herbicides

These chemicals are applied after the crop plants are up, or after the crop has been transplanted. Applied as directed, the weeds can be killed without injury to the crop. The weeds should be small for best results.

ASPARAGUS

Note: All treatments should be applied in 150 to 300 L water per hectare unless otherwise specified.

Before Emergence of Direct-Seeded Asparagus

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annuals	paraquat GRAMOXONE (200 g/L)	0.6 to 1.1 kg/ha 3.0 to 5.5 L/ha	Apply in 300 to 1100 L water per hectare. Spray on emerged weeds before crop emergence. Preemergence to next crop of weeds. DO NOT USE TANK-MIX. Direct seeding of asparagus is only practical if weeds can be controlled from the time of seeding until the asparagus plants develop an extensive root system. Paraquat can be used as a "chemical mower" to kill emerged seedling weeds when the first asparagus seedlings are beginning to emerge. Soon after this application, the chloramben premergence treatment should be made to extend the period of weed control. To be effective these must be separate applications.
	chloramben AMIBEN (240 g/L)	2.25 to 3.25 kg/ha 9.45 to 13.65 L/ha	

ASPARAGUS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS

1st Year Crown-Established

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annuals	chloramben AMIBEN (240 g/L) AMIBEN (10 Gr)	2.25 to 3.25 kg/ha 9.45 to 13.65 L/ha 22.5 to 32.5 kg/ha	On seedling asparagus, chloramben should be applied as a preemergence spray, or as a granular application on emerged seedlings. Use 2.25 kg on sandy soils and 3.25 kg on clay soils. Do not use on marketable asparagus as a residue tolerance has not been established.
	naptalan ALANAP (240 g/L)	4.5 to 6.75 kg/ha 18.90 to 28.35 L/ha	Preemergence. Use the lighter rate on sandy soil, the higher rate on heavier soil types.

2nd Year and Established Asparagus

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annuals	diuron KARMEX (80 WP) linuron LOROX (50 WP) AFOLAN F (450 g/L) LOROX L (480 g/L) metribuzin SENCOR (500 g/L) simazine PRINCEP (80 WP) PRINCEP-NINE-T (90 SG)	1.75 to 2.25 kg/ha 2.1 to 2.7 kg/ha 1.75 to 2.25 kg/ha 3.50 to 4.50 kg/ha 4.0 to 5.0 L/ha 3.5 to 4.5 L/ha 1.10 to 2.25 kg/ha 2.25 to 4.5 kg/ha 1.75 to 3.25 kg/ha 2.75 to 3.9 kg/ha 1.75 to 3.25 kg/ha	Disk before any shoots appear in the spring on established plantings. This may be followed by one of the following herbicides. Linuron, diuron, metribuzin or simazine should be applied immediately after the spring disking before weeds germinate. A second application may be made after the postharvest disking. The lower rates are recommended for lighter soils. CAUTION: Rates are given for overall sprays. Reduce proportionately if only rows are sprayed.

Before Spear Emergence or After Last Cutting

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	paraquat GRAMOXONE (200 g/L)	0.6 to 1.1 kg/ha 3.0 to 5.5 L/ha	Apply in 300 to 1100 L water per hectare. Paraquat should also be applied on weed seedlings before asparagus tips appear or after the last cutting. Do not apply to emerged spears which are to be used for human consumption. It is particularly effective for control of grass. Use the higher volume of water on dense weed growth.
	paraquat/simazine TERRAKLENE (500 g/L)	2.0 to 3.25 kg/ha 4.0 to 6.5 L/ha	The paraquat/simazine formulation can be applied after weed emergence but before crop emergence. A second application may be applied after harvest. These treatments are recommended for

established plantings only and must not be used on direct seeded asparagus or on young plants during the first growing season after planting. Use the lower rate on sandy soils or on soils low (1 to 2%) in organic matter.

During Harvest Immediately After Cutting

Non-grass annuals, some perennials	2,4-D amine	1.10 to 1.75 kg/ha	Apply in 50 to 100 L water per hectare. May be applied early in the season just after a cutting.
Seedling annual grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	2.5 to 5.0 kg/ha 3.25 to 6.5 kg/ha 3.25 to 6.5 kg/ha	Apply in 50 to 100 L water per hectare. Dalapon and 2,4-D may be combined to control both broadleaf and grass weeds. Dalapon may be used once during the growing season. For quack grass control, apply after the last cutting and before the last disking. For a spot treatment, spray until the leaves are wet.

After Last Cutting

Perennial Weeds	amitrole AMITROLE-T (240 g/L) CYTROL (240 g/L)	4.5 kg/ha 18.9 L/ha 18.9 L/ha	Amitrole may be used as a spot treatment to control small patches of perennial weeds. The application should be made when the weeds are actively growing. Apply with a knapsack or garden sprayer to wet the leaves of the weeds, avoiding the asparagus leaves as much as possible. For larger area mow after the last cutting and spray immediately.
	2,4-D amine	1.10 to 1.75 kg/ha	Apply in 50 to 100 L water per hectare. Apply three weeks after the postcutting disking. Direct spray to avoid wetting asparagus tops.
Quack grass	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	8.5 to 12.5 kg/ha 11.05 to 16.25 kg/ha 11.05 to 16.25 kg/ha	For spot treatments use 1 kg/ha product in 45 L water.

Control of redroot pigweed is important to reduce the possibility of infestations of the amaranth case bearer. This weed should also be controlled on the headlands and margins of the field.

BEANS (LIMA)

Note: Use 150 to 300 litres of water per hectare unless stated otherwise.

Preplant Incorporated

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses	trifluralin TREFLAN (545 g/L)	0.6 to 0.8 kg/ha 1.1 to 1.5 L/ha	Trifluralin must be applied before planting and incorporated into the soil. Incorporation should be done as soon as possible but within 8 hours in 2 directions. Use the higher rate on clay soil and the lower rate on sandy soil. Ragweed, American nightshade, nutsedge, velvetleaf, and mustard are not controlled and lady's-thumb may escape. The use of metobromuron or monolinuron preemergence or bentazon postemergence will control the weeds that usually escape the trifluralin treatment.

Preemergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating common annual broadleaf weeds including ragweed, lamb's-quarters, pigweed and mustards	metobromuron PATORAN FL (400 g/L) or PATORAN FL (670 g/L)	1.34 to 1.68 kg/ha 3.35 to 4.2 L/ha 2.0 to 2.5 L/ha	Metobromuron and monolinuron control annual broadleaf weeds. Annual grasses may be partially controlled but are the first to escape, and rotary hoeing or cultivation may be necessary to give complete weed control. Use the lower rate on light-textured soils, but do not use on sandy soils of less than 3% organic matter. Beans should be seeded at least 5 cm deep. Injury may occur if beans are under stress. Beans in the early stages of growth may also be injured from treated soil having been splashed up onto the leaves by a rainstorm. A shallow harrowing or rotary hoeing after application of the chemical will reduce the possibility of splash-up as well as help activate the chemical if dry weather follows application.
	monolinuron AFESIN (200 g/L)	1.1 to 1.75 kg/ha 5.5 to 8.75 L/ha	

Germinating annual weeds	chloramben AMIBEN (240 g/L)	2.25 to 3.25 kg/ha 9.4 to 13.6 L/ha	Use the lower rate (2.25 kg/ha active) for sandy soil and the higher rate (3.25 kg/ha active) for clay soil. Chloramben controls most annual broadleaf weeds and grasses with the exception of mustards for at least 8 weeks after application. Delayed maturity of lima beans may occur if heavy rainfall follows application of this chemical. If dry weather follows application, a shallow cultivation, harrowing, or rotary hoeing may be used to improve weed control and help in breaking a soil crust without reducing chemical action.

Postemergence

Emerged annual broadleaf weeds, yellow nutsedge, Canada thistle and suppression of field bindweed	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha 1 L/ha	Use 200 to 400 L of water per hectare. Apply when beans are in unifoliate to 4th trifoliate-leaf stage and weeds are small and actively growing. Velvetleaf (15 cm), smartweed (20 cm) and cocklebur (30 cm) are controlled. Top growth of Canada thistle, yellow nutsedge and field bindweed is controlled but 2 applications 10 days apart may be required. A new flush of weeds may emerge after the first flush has been controlled. Temporary crop injury may occur under hot, humid conditions. Cool weather or drought may delay control.
Green and yellow foxtail, barnyard grass, old witch grass, wild oats, fall panicum, and volunteer corn	diclofop-methyl HOE-GRASS (190 g/L)	1.0 kg/ha 5.3 L/ha	Diclofop-methyl should be applied postemergence to annual grasses and volunteer corn in the 1- to 4-leaf stage (optimum control at the 2- to 3-leaf stage approximately 10 to 16 days after emergence). Do not apply if rain is expected within one hour after application. Other herbicides should not be tank-mixed with diclofop-methyl. Other postemergence herbicides should be applied 4 days before or after diclofop-methyl application. Annual broadleaf weeds must be controlled with other herbicides.

Split Applications

Germinating annual broadleaf weeds and grasses	trifluralin or TREFLAN (545 g/L)	0.6 to 0.8 kg/ha 1.1 to 1.5 L/ha	See remarks on trifluralin under the preplant incorporated section.
	followed by metobromuron	1.17 to 1.34 kg/ha	See remarks on metobromuron and monolinuron under the preemergence section.
	PATORAN FL (400 g/L) or PATORAN FL (670 g/L)	2.9 to 3.4 L/ha 1.75 to 2.0 L/ha	

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	or by monolinuron AFESIN (200 g/L)	1.1 to 1.4 kg/ha 5.5 to 7.0 L/ha	
	or by bentazon plus oil concentrate BASAGRAN (480 g/L) plus ASSIST	0.85 to 1.1 kg/ha 1.75 to 2.25 L/ha 1 L/ha	See remarks on bentazon under the postemergence section.

BEETS (RED)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Preplant Incorporated			
Germinating grasses	pebulate TILLAM (720 g/L) cycloate RO-NEET (720 g/L)	4.50 to 6.75 kg/ha 6.30 to 9.25 L/ha 3.25 to 4.50 kg/ha 4.75 to 6.25 L/ha	Apply in 150 to 300 L water per hectare. Use on mineral soils only. Pebulate and cycloate should be applied to a dry soil surface before planting and incorporated. Use the lower rate on sandy soils. These treatments are usually not effective on highly organic soils.
Germinating broadleaf weeds	pyrazon PYRAMIN (80WP)	4.5 to 5.5 kg/ha 5.4 to 6.6 kg/ha	Apply in 150 to 300 L water per hectare. Use only on mineral soils.
Germinating grasses	TCA (NaTA)	5.50 to 6.75 kg/ha	Use only on mineral soils.
Germinating grasses and broadleaf weeds	pyrazon PYRAMIN (80WP) plus TCA (NaTA)	4.5 to 5.5 kg/ha 5.4 to 6.6 kg/ha 3.25 to 5.50 kg/ha	Pyrazon is best applied at planting time as a preemergence banded treatment for the control of most annual broadleaf weeds. The combination of pyrazon and TCA is most useful where both annual broadleaf weeds and grasses are a problem. These treatments may not be effective on high organic soils or where dry soil conditions prevail and consequently may not be useful on muck soils or on late planted beets (dry soil conditions). Under these circumstances

pyrazon can be applied postemergence to the beets and weeds as a band over the row. Apply after the first true leaf of the beets is 2.5 cm long and before the weeds have reached the 4-true-leaf stage (10 cm). This treatment will control most annual broadleaf weeds. If TCA is used, beet tops should not be fed to livestock. If the beet crop fails and must be disked after treatment with TCA do not plant corn because TCA residues will persist throughout the season.

Postemergence

Annual broadleaf weeds	pyrazon PYRAMIN (80WP)	3.75 to 4.50 kg/ha 4.5 to 5.4 kg/ha	Apply in 1/3 to 1/2 L Citowett Plus or in 7 L emulsifiable light mineral oil and 300 to 400 L water per hectare. Oil should be light paraffin- based oil having 95 to 110 US viscosity with over 90% of unsulfonatable residues and suitably emulsified.

CABBAGE, CAULIFLOWER, BROCCOLI, BRUSSELS SPROUTS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Preplant Incorporated			
Germinating annual grasses and some broadleaf weeds	trifluralin TREFLAN (545 g/L)	0.60 to 1.1 kg/ha 1.1 to 2.1 L/ha	Apply in 150 to 300 L water per hectare. Preplant incorporated for direct-seeded cabbage or cauliflower, or transplanted cabbage, cauliflower, broccoli and brussels sprouts. Trifluralin must be applied before planting and incorporated immediately into the soil. Use the higher rate on clay soil and the lower rate on sand. Annual nightshade, ragweed, and mustards are not controlled, and lady's-thumb may escape the treatment. Annual grass control is usually excellent.
Preemergence			
Germinating grasses and some broadleaf weeds	chlorthal dimethyl DACTHAL (75WP)	9 to 11 kg/ha 11.7 to 14.3 kg/ha	Apply in 250 L water per hectare on mineral soils. Apply immediately after seeding or directly over transplants, preemergence to weeds. Chlorthal dimethyl must be applied uniformly to the soil as a spray. This herbicide can be sprayed directly over transplants without injury. If weeds have emerged, cleanly cultivate the soil before application. Rainfall or irrigation (about 1 cm) is necessary for activation.

CARROTS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Preplant Incorporated			
Germinating annual grasses and broadleaf weeds	trifluralin TREFLAN (545 g/L)	0.6 to 1.1 kg/ha 1.1 to 2.1 L/ha	Apply in 150 to 300 L water per hectare overall, preplant incorporated, on mineral soils only. Trifluralin must be applied before planting and incorporated into the soil (see "Incorporation," page 45). Use the higher rate on clay soil and the lower rate on sand. Do not use on muck soils. Ragweed and mustards are not controlled, and lady's-thumb may escape the treatment. If shallow cultivation is to be used to control these escaped weeds cultivation should start when the weeds have reached the 3- to 4-leaf stage.
Preemergence			
Annuals	linuron LOROX (50WP) AFOLAN F (450 g/L) LOROX L (480 g/L)	0.6 to 1.1 kg/ha 1.25 to 2.25 kg/ha 1.25 to 2.5 L/ha 1.1 to 2.3 L/ha	Apply in 150 to 300 L water per hectare. Linuron, when used as a preemergence treatment should be applied soon after seeding. Use the lower rate on sandy soils. Carrots are very sensitive to this treatment at time of emergence and severe injury can take place if there is a heavy rain, or if the area is irrigated, at this time. When used as a postemergence treatment, apply after carrots are 8 cm high. The carrot leaves will become yellow or light green but they will soon regain their normal green color. Do not use more than 1.1 kg per hectare on sandy soils. Injury may occur when spraying is done during hot, dry weather, or when the crop is under stress. For preemergence plus postemergence treatment use a maximum of 0.8 kg (active) in the second spray.
	prometryne GESAGARD (80WP)	1.10 to 2.25 kg/ha 1.32 to 2.70 kg/ha	Apply in 150 to 300 L water per hectare. Prometryne should also be applied soon after seeding. IT IS NOT REGISTERED FOR POSTEMERGENCE USE. A preplanting application of trifluralin on mineral soils can provide control of most weeds, until the carrots have developed to the stage at which the linuron postemergence treatment, as recommended

above, can be used. On muck soils, a combination procedure which has been successful is to use the preemergence prometryne treatment followed by a postemergence linuron treatment as required.

Postemergence

	herbicidal oil	600 to 800 L/ha (overall spray) 300 to 400 L/ha (rows only) undiluted	Apply the selective herbicidal oil as soon as true leaves develop and before roots of carrots are thicker than a pencil. Later treatments may produce an oil flavor. Weeds should be less than 10 cm high. Ragweed, wormwood, and wild carrot are not controlled.
	linuron LOROX (50WP) AFOLAN F (450 g/L) LOROX L (480 g/L)	1.10 to 2.25 kg/ha 2.25 to 4.50 kg/ha 2.5 to 5.0 L/ha 2.25 to 4.5 L/ha	Apply in 150 to 300 L water per hectare after carrots are 8 to 15 cm high.
Green and yellow foxtail, barnyard grass, fall panicum, old witch grass, wild oats and volunteer corn.	diclofop-methyl HOE-GRASS (190 g/L)	1.0 kg/ha 5.3 L/ha	Diclofop-methyl should be applied post- emergence to annual grasses in the 1- to 4-leaf stage (optimum control at 2- to 3-leaf stage, approximately 10 to 16 days after emergence). Do not apply if rain is expected within one hour after application. Other herbicides should not be tank-mixed with diclofop-methyl to avoid inactivating it. Other postemergence herbicides should be applied 4 days before or after diclofop-methyl application.

CELERY

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Seedling annuals	herbicidal oil	600 to 800 L/ha (overall spray) 300 to 400 L/ha (rows only) undiluted	Herbicidal oil should be used only on outdoor seedbed and only if the soil is moist. Apply as the true leaves develop on the celery and before weeds are 10 cm high.
	linuron AFOLAN F (450 g/L)	1.10 to 2.25 kg/ha 2.25 to 5.0 L/ha	Apply in 150 to 300 L water per hectare in the transplanted crop. Linuron should be applied 8 to 10 days after transplanting. Some yellowing of the leaves may be noticed but this will be temporary.
	prometryne GESAGARD (80WP)	2.25 kg/ha 2.75 kg/ha	Apply in 150 to 300 L water per hectare in the transplanted crop. Do not use on direct- seeded crop. Prometryne applications should be delayed 8 to 10 days on the transplanted crop until the celery plants are established.

CUCUMBER

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annuals	naptalam ALANAP (240 g/L)	4.50 to 6.75 kg/ha 18.90 to 28.35 L/ha	Apply in 150 to 390 L water per hectare. Apply naptalam immediately after seeding the crop and before weed seeds have germinated. Naptalam may also be used on transplanted cucumbers after the plants have been established in the field and before weed seeds germinate. Soil should be smooth and moist when treating. Application of 1 cm of irrigation water immediately after spraying naptalam will improve weed control if soil is dry. Use the lower rate on sandy soils. Temporary stunting and injury occurs if naptalam is leached into the root zone of germinating or developing cucumber seedlings.
	naptalam + dinoseb DYANAP (360 g/L)	5 to 6 kg/ha 14.0 to 16.8 L/ha	Applied immediately after seeding. The naptalam + dinoseb mixture provides more consistent weed control in dry soil and better annual grass control than naptalam. The mixture allows the use of a safe rate of dinoseb. Use the lower rates on sandy soil. Soil should be smooth and level when treating. Seed cucumbers 2 to 2.5 cm deep. Temporary stunting and injury occur if the chemical is leached into the root zone of germinating or developing cucumber seedlings. Use lower rates on sandy soils.
Germinating annual grasses	bensulide PREFAR (480 g/L)	5.75 to 6.75 kg/ha 12.0 to 14.0 L/ha	Preplant incorporated on mineral soils only.
Germinating annual broadleaf weeds and grasses	bensulide PREFAR (480 g/L) followed by naptalam ALANAP (240 g/L)	4.5 to 6.75 kg/ha 9.5 to 14.0 L/ha 2.25 to 4.5 kg/ha 9.5 to 19 L/ha	Bensulide and naptalam may also be tank- mixed and applied preplant soil incorporated for broad-spectrum weed control. Bensulide should be applied before planting and incorporated thoroughly into the soil to a depth of 2.5 to 5 cm. Do not use on muck soils. When tank mixed with naptalam incorporation should be to a depth of 2.5 cm or less. Use power driven rotary cultivators or other equipment which will result in satisfactory incorporation. Use the lower rates in light sandy soils.

DILL (See Herbicidal Oil under Carrots, page 87)

LETTUCE

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annuals	chlorpropham CIPC (480 g/L)	4.50 to 6.75 kg/ha 9.45 to 14.20 L/ha	Apply in 150 to 300 L water per hectare. When overhead irrigation is used at seeding time, delay chlorpropham application until after first irrigation but before crop emergence. Use lower rates in cool wet weather to avoid injury and delay in emergence. Use lower rates in mineral soils.

MUSKMELON, WATERMELON, SQUASH AND PUMPKIN

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annuals	naptalam ALANAP (240 g/L)	4.50 to 6.75 kg/ha 18.90 to 28.35 kg/ha	Apply in 150 to 300 L water per hectare. Apply naptalam immediately after seeding the crop and before weed seeds have germinated. Naptalam should be used immediately after seeding on muskmelon, citron, watermelon and squash; or after the crop emerges on citron, muskmelon and watermelon. Naptalam may also be used on transplanted muskmelons after the plants have been established in the field and before weed seeds germinate. DO NOT USE ON BUTTERNUT SQUASH, or PUMPKIN. Soil should be smooth and moist when treating. Application of 1 cm of irrigation water immediately after spraying naptalam will improve weed control if soil is dry. Temporary stunting and injury occur if the chemical is leached into the root zone of germinating or developing seedlings. Use lower rates on sandy soils.
	chloramben AMIBEN (240 g/L)	2.25 to 3.25 kg/ha 9.45 to 13.65 L/ha	Apply in 150 to 300 L water per hectare. Use in pumpkin and squash fields only. DO NOT USE chloramben FOR MUSKMELON AND WATERMELON. Apply chloramben immediately after seeding squash or pumpkin to control most annual broadleaf weeds and grasses. Stunting and delayed maturity may result if heavy rainfall follows application. If dry weather continues after applications a light cultivation may be used to improve weed control and remove emerged weeds.

ONIONS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Seedling annuals	ioxynil TOTRIL (225 g/L)	0.45 kg/ha 2.0 L/ha	Apply in 400 L water per hectare. Apply postemergence after the crop has 3 true leaves. Ioxynil is used as a postemergence herbicide to control seedling broadleaf weeds when they are small (up to 5-6-leaf stage). Repeat applications may be made. Some injury to the onion leaves may occur, but this should not affect crop yield. This herbicide is registered for use on leeks at the rate given above. Does not control grasses.
Germinating annuals and seedling grasses	allidochlor RANDOX, CDAA (480 g/L) (20% Gr)	3.25 to 6.70 kg/ha 6.82 to 14.00 L/ha 16.25 to 33.50 kg/ha	PERMITS are required from the Ministry of the Environment under the Pesticides Act 1973 for the use of RANDOX (allidochlor). Permit applications should be made to the Ministry of the Environment Pesticide Control Field officers (see page 143). Apply in 150 to 300 L water per hectare or granular. Pre- or postemergence to crops on muck soils only. Allidochlor is effective against many of the annual weeds found in onions, and is particularly useful on muck soils high in organic matter. Granular postemergence treatments should be made either following a cultivation or before the effect of the previous treatment has been lost. For example, 4.5 kg per hectare applied 4 to 6 weeks after the previous treatment can be used. The chemical is irritating to both eyes and skin.
	chlorpropham CIPC (480 g/L) CIPC (10% Gr) CIPC (20% Gr)	4.5 to 9 kg/ha 9.45 to 18.9 L/ha 45 to 90 kg/ha 22.5 to 45 kg/ha	Apply in 150 to 300 L water per hectare, or granular, on muck soils. Use 4.50 to 6.75 kg (active) on mineral soils. Pre- or directed postemergence. Chlorpropham is most effective when the weed seeds are germinating. Under cool, moist conditions reduction in stand with decrease in yields has occurred. Direct the postemergence spray to avoid onion leaves. Excellent control of purslane may be obtained. Groundsel, lamb's-quarters, and ragweed are somewhat resistant. Do not use this chemical on bunching onions.
	chlorpropham + allidochlor	3.25 kg/ha of each	Apply in 150 to 300 L water per hectare, preemergence. Chlorpropham-allidochlor mixtures are successful when soil moisture and temperature are most suitable for germination of the weed seeds. In seasons when the soil is very dry and warm the chlorpropham may evaporate and weed control will be poor. PERMIT required, see above.

Germinating grasses and some broadleaf weeds	chlorthal dimethyl DACTHAL (75WP)	9 to 11 kg/ha 11.7 to 14.3 kg/ha	Apply in at least 250 L water per hectare, preemergence on mineral soils. Chlorthal dimethyl should be applied as a preemergence treatment as it kills germinating weed seeds only. It is not effective on muck soils.
Green and yellow foxtail, barnyard grass, fall panicum, old witch grass, wild oats and volunteer corn	diclofop-methyl HOE-GRASS (190 g/L)	1.0 kg/ha 5.3 L/ha	Diclofop-methyl should be applied post- emergence to annual grasses in the 1- to 4-leaf stage (optimum control at 2- to 3-leaf stage, approximately 10 to 16 days after emergence). Do not apply if rain is expected within one hour after application. Other herbicides should not be tank mixed with diclofop-methyl to avoid inactivating it. Other postemergence herbicides should be applied 4 days before or after diclofop-methyl application. Most experience with the above herbicides has been with the seeded crop. Experience with sets and limited experience with Spanish onions have been satisfactory. On green bunching onions, the granular formulations (applied when the leaves are dry) are recommended to avoid leaf injury.

PARSLEY (See Herbicidal Oil under Carrots, page 87)

PARSNIPS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Preemergence			
Germinating annuals	chlorpropham CIPC (480 g/L) CIPC (20 Gr)	4.5 to 9.0 kg/ha 9.45 to 18.9 L/ha 22.50 to 45.0 kg/ha	Chlorpropham should be used at the lower rate on mineral soils and at the higher rate on muck. Apply at time of seeding or up till shortly before emergence of crop and weeds.
	linuron AFOLAN F (450 g/L)	1.10 to 2.25 kg/ha 2.5 to 5.0 L/ha	Apply in 150 to 300 L water per hectare at seeding. Linuron, when used as a preemergence treatment, should be applied soon after seeding. Use lower rate on sandy soils. Heavy rains or irrigation at time of emergence may cause injury from chemical. When used postemergent, apply after parsnips are 8 cm high. Do not use more than 1.1 kg (active) on sandy soils. Applications made when the temperature is high may cause injury, especially at the higher rates.

PARSNIPS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS

Postemergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged weeds	herbicidal oil	600 to 800 L/ha (overall spray) or 300 to 400 L/ha (row only) undiluted	Herbicidal oil should be applied as soon as true leaves develop and before roots of parsnips are thicker than a pencil. Later treatments may produce an oil flavour. Weeds should be less than 10 cm high.
	linuron AFOLAN F (450 g/L)	1.10 to 2.25 kg/ha 2.5 to 5.0 L/ha	Apply in 150 to 300 L water per hectare, after parsnips are 8 to 15 cm high (see note above).

PEPPERS

Note: All treatments should be applied in 150 to 300 L water per hectare.

Weed control in the pepper crop is accomplished best by combining chemical and cultural methods. Discussion of cultural methods can be found in the corn section.

Preplant Incorporated

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses and some control of lamb's quarters and pigweed including triazine resistant species.	trifluralin TREFLAN (545 g/L)	0.60 to 1.1 kg/ha 1.1 to 2.1 L/ha	Applied preplant. Immediate incorporation is recommended, however, delay of incorporation up to 8 hours after application, if necessary, will not likely result in any loss of activity. Effective on mineral soils but poor activity on highly organic soils (muck, peat).

After Transplant Established

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses and broadleaf weeds	chloramben granular AMIBEN (10G)	4.5 kg/ha 45 kg/ha	Apply 2 weeks after transplanting after crop is established but preemergence to weeds. Control weed escapes with cultivation. Do not apply chloramben granular to wet pepper foliage. Mustards and cocklebur are not controlled.

Germinating annual grasses and some broadleaf weeds	diphenamid ENIDE (50WP)	4.50 to 6.75 kg/ha 9.0 to 13.5 kg/ha	Apply soon after transplanting but preemergence to weeds. Diphenamid residues in the soil have caused damage to fall seeded wheat or rye. Banding the treatment, fall plowing, adequate rainfall and warm temperatures assist in reducing residues.
Germinating annual grasses	chlorthal dimethyl DACTHAL (75WP)	9 to 11 kg/ha 12 to 14.7 kg/ha	Apply 2 weeks after planting to established transplants but preemergence to weeds. Cultivate to control weed escapes. Not effective on muck soils.

POTATOES

Note A combination of chemical weed control with cultivation provides the best weed management system. Cultivation prior to potato emergence using various kinds of cultivation equipment (light harrows, finger weeders, killers, etc.) will control the early flush of weeds. Root pruning of the crop should be minimized. If the crop is hilled after application of herbicides, it must be realized that areas of untreated soil will surface and may result in another flush of weeds in these areas.

Preplant Incorporated

(Two incorporations at right angles operating at a depth of 10 cm using a double disk (7-10 km/h) or a vibrating shank (S-tine) cultivator (10-13 km/h) are recommended soon after the herbicide application.)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses	EPTC EPTAM (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	Apply EPTC to a dry soil surface before planting and incorporate immediately. When applied under wet soil conditions weed control is poor.
Germinating annual grasses and broadleaf weeds	EPTC EPTAM (800 g/L) plus metribuzin SENCOR (500 g/L) or	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha 0.6 to 0.85 kg/ha 1.2 to 1.7 L/ha	Apply as a tank mix in 220 to 330 L water per hectare. Do not use on muck soils. Do not use on BELLEISLE OR TOBIQUE varieties.
Nutsedge and germinating annual grasses	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha	May be followed by metobromuron or metribuzin applied preemergence. See above.
Nutsedge	EPTC EPTAM (800 g/L)	4.4 to 6.8 kg/ha 5.5 to 8.5 L/ha	Apply EPTC to a dry soil surface before planting and incorporate immediately. Use high rates for heavy weed infestations.

PARSNIPS (Cont'd)

Postemergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged weeds	herbicidal oil	600 to 800 L/ha (overall spray) or 300 to 400 L/ha (row only) undiluted	Herbicidal oil should be applied as soon as true leaves develop and before roots of parsnips are thicker than a pencil. Later treatments may produce an oil flavour. Weeds should be less than 10 cm high.
	linuron AFOLAN F (450 g/L)	1.10 to 2.25 kg/ha 2.5 to 5.0 L/ha	Apply in 150 to 300 L water per hectare, after parsnips are 8 to 15 cm high (see note above).

PEPPERS

Note: All treatments should be applied in 150 to 300 L water per hectare.

Weed control in the pepper crop is accomplished best by combining chemical and cultural methods. Discussion of cultural methods can be found in the corn section.

Preplant Incorporated

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses and some control of lamb's quarters and pigweed including triazine resistant species.	trifluralin TREFLAN (545 g/L)	0.60 to 1.1 kg/ha 1.1 to 2.1 L/ha	Applied preplant. Immediate incorporation is recommended, however, delay of incorporation up to 8 hours after application, if necessary, will not likely result in any loss of activity. Effective on mineral soils but poor activity on highly organic soils (muck, peat).

After Transplant Established

Germinating annual grasses and broadleaf weeds	chloramben granular AMIBEN (10G)	4.5 kg/ha 45 kg/ha	Apply 2 weeks after transplanting after crop is established but preemergence to weeds. Control weed escapes with cultivation. Do not apply chloramben granular to wet pepper foliage. Mustards and cocklebur are not controlled.

Germinating annual grasses and some broadleaf weeds	diphenamid ENIDE (50WP)	4.50 to 6.75 kg/ha 9.0 to 13.5 kg/ha	Apply soon after transplanting but preemergence to weeds. Diphenamid residues in the soil have caused damage to fall seeded wheat or rye. Banding the treatment, fall plowing, adequate rainfall and warm temperatures assist in reducing residues.
Germinating annual grasses	chlorthal dimethyl DACTHAL (75WP)	9 to 11 kg/ha 12 to 14.7 kg/ha	Apply 2 weeks after planting to established transplants but preemergence to weeds. Cultivate to control weed escapes. Not effective on muck soils.

POTATOES

Note A combination of chemical weed control with cultivation provides the best weed management system. Cultivation prior to potato emergence using various kinds of cultivation equipment (light harrows, finger weeders, killers, etc.) will control the early flush of weeds. Root pruning of the crop should be minimized. If the crop is hilled after application of herbicides, it must be realized that areas of untreated soil will surface and may result in another flush of weeds in these areas.

Preplant Incorporated

(Two incorporations at right angles operating at a depth of 10 cm using a double disk (7-10 km/h) or a vibrating shank (S-tine) cultivator (10-13 km/h) are recommended soon after the herbicide application.)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses	EPTC EPTAM (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	Apply EPTC to a dry soil surface before planting and incorporate immediately. When applied under wet soil conditions weed control is poor.
Germinating annual grasses and broadleaf weeds	EPTC EPTAM (800 g/L) plus metribuzin SENCOR (500 g/L) or	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha 0.6 to 0.85 kg/ha 1.2 to 1.7 L/ha	Apply as a tank mix in 220 to 330 L water per hectare. Do not use on muck soils. Do not use on BELLEISLE OR TOBIQUE varieties.
Nutsedge and germinating annual grasses	metolachlor DUAL (960 g/L)	1.92 to 2.64 kg/ha 2 to 2.75 L/ha	May be followed by metobromuron or metribuzin applied preemergence. See above.
Nutsedge	EPTC EPTAM (800 g/L)	4.4 to 6.8 kg/ha 5.5 to 8.5 L/ha	Apply EPTC to a dry soil surface before planting and incorporate immediately. Use high rates for heavy weed infestations.

POTATOES (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Quackgrass	dalapon DALAPON (74 SP), DOWPON 74SP or BASFAPON (74 SP)	8.5 kg/ha 11 kg/ha	Apply to grass foliage. Wait three days before completing cultivation. May be used on white skinned varieties or on red varieties where loss of color is not serious from a market point of view.

Split Applications

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Nutsedge and germinating annuals	metolachlor DUAL (960 g/L) followed by one of	1.92 to 2.64 kg/ha 2 to 2.75 L/ha	Apply metolachlor and incorporate thoroughly. Use one of the other chemicals preemergence to weeds and crop after the first hilling. Do not use metribuzin on muck soils or on the varieties BELLEISLE or TOBIQUE.
	metobromuron PATORAN (670 g/L)[1]	1.17 to 1.68 kg/ha 1.75 to 2.5 L/ha	
	or linuron LOROX (50WP)[2]	0.88 to 1.12 kg/ha 1.75 to 2.25 kg/ha	
	or monolinuron AFESIN (200 g/L)	1.1 to 1.7 kg/ha 5.5 to 8.5 L/ha	
	or metribuzin SENCOR (500 g/L)[3]	0.56 to 1.12 kg/ha 1.12 to 2.25 L/ha	

Preemergence Or At Emergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annuals	alachlor LASSO (480 g/L) tank-mixed with one of the following	2.25 kg/ha 4.7 L/ha	Alachlor can be applied as a TANK-MIX with either of the herbicides mentioned before emergence of both crop and weeds. Better weed control is obtained when the application of alachlor/dinoseb mixture is delayed until the weeds are up but before the potato plants emerge. These mixtures provide better control of seedling grasses than linuron or dinoseb alone. Do not incorporate into the soil. Do not use on sands or sandy loams or on soils with less than 1% organic matter.
	dinoseb DINITRO (600 g/L)	3.25 to 5.5 kg/ha 5.5 to 9.3 L/ha	
	or linuron (50WP) LOROX, AFOLAN[4]	1.1 to 2.25 kg/ha 2.2 to 4.5 kg/ha	
	chloramben/linuron AMILON (50 WP)	2.25 kg/ha 4.5 kg/ha	This commercial mixture should be applied preemergence to the crop and weeds after the first hilling.
	dinoseb AMINE DINITRO (360 g/L)	3.25 to 5.5 kg/ha 9.1 to 15.4 L/ha	Dinoseb should be applied 2 to 3 days before the potatoes emerge. It provides a shorter period of weed control than the other herbicides listed.

	metolachlor	1.92 to 2.64 kg/ha	Metolachlor as a tank mix plus one of the herbicides listed should be applied before emergence of the crop and weeds after the first hilling. Do not use metribuzin on muck soils or on the varieties BELLEISLE or TOBIQUE. Use the lower rates on sandy soil.
	DUAL (960 g/L)	2 to 2.75 L/ha	
	tank-mixed with one of the following		
	metobromuron	1.17 to 1.68 kg/ha	
	PATORAN (670 g/L)[1]	1.75 to 2.5 L/ha	
	or monolinuron	1.1 to 2.25 kg/ha	
	AFESIN (200 g/L)	5.5 to 11.25 L/ha	
	or metribuzin	0.56 to 1.12 kg/ha	
	SENCOR (500 g/L)[3]	1.12 to 2.25 L/ha	
	linuron	1.1 to 2.25 kg/ha	Linuron can be applied immediately after hilling but all the potato tops must be covered with soil or the potato plants will be injured. Use the lower rate on light sandy soils and the higher rate on muck or clay soils.
	LOROX (50 WP)	2.2 to 4.5 kg/ha	
	AFOLAN (450 g/L)	2.4 to 5 L/ha	
	monolinuron	1.1 to 2.25 kg/ha	Monolinuron can be applied immediately after hilling but all the potato tops must be covered with soil or the crop will be injured. Use the lower rate on soils low in organic matter and the higher rate on clay or soils high in organic matter.
	AFESIN (200 g/L)	5.5 to 11.25 L/ha	
	metribuzin	0.6 to 1.1 kg/ha	Apply after hilling before emergence of crop or weeds. DO NOT USE ON MUCK SOILS. Use the lower rate on sandy soil. Do not use on the varieties BELLEISLE or TOBIQUE.
	SENCOR (500 g/L)[3]	1.1 to 2.25 L/ha	
	LEXONE (75 DF)	0.7 to 1.5 kg/ha	
	metribuzin	0.6 to 0.85 kg/ha	Apply as a TANK-MIX before potatoes emerge. May be used on white varieties of potatoes and on red skinned varieties where loss of color is not serious from a marketing point of view. See above note.
	SENCOR (500 g/L)[5] plus	1.2 to 1.7 L/ha	
	dalapon	8.5 kg/ha	
	DALAPON, (74SP) or	11.5 kg/ha	
	DOWPON (74SP) or		
	BASFAPON (74SP)		
	prometryne	2.20 to 2.6 kg/ha	Addition of a surfactant or an emulsifiable oil will improve control where annual grasses predominate. Apply on small weeds just before or at emergence of the crop. Use the lower rate on coarse sandy soils.
	GESAGARD (80 WP)	2.75 to 3.25 kg/ha Use 3.40 kg/ha on muck soils. (4.25 kg/ha of 80WP)	
Emerged weeds	paraquat	0.6 to 0.85 kg/ha	Apply in 275 to 550 L water per hectare to emerged weeds. Use on nettled gem and cherokee before emergence. Apply on other varieties until 25 to 30% of the crop has emerged but none of the tops should be over 5 to 8 cm in height. Temporary yellowing of the tops will occur. Do not use on emerged potato plants in the evening, under cloudy conditions or when the plants are under moisture stress.
	GRAMOXONE (200 g/L)	3 to 4.25 L/ha	

POTATOES (Cont'd)

[1] *Patoran (50 WP) equivalent is 2.35 to 3.25 kg/ha.*
[2] *Afolan F (450 g/L) equivalent is 2.4 to 3.8 L/ha.*
[3] *Lexone (480 g/L) equivalent is 1.2 to 2.3 L/ha.*
[4] *Afolan F (450 g/L) equivalent is 2.4 to 5 L/ha.*
[5] *Lexone (480 g/L) equivalent is 1.2 to 1.8 L/ha.*

Postemergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Late germinating grasses	EPTC EPTAM (800 g/L)	3.4 to 4.4 kg/ha 4.25 to 5.5 L/ha	Incorporate immediately at next to the last or last cultivation. This treatment may be of value if an earlier treatment has failed or if late germinating grasses are a problem.
Annual grasses, wild oats and volunteer corn	diclofop-methyl HOE-GRASS (190 g/L)	1 kg/ha 5.3 L/ha	DO NOT USE IN TANK-MIX WITH OTHER HERBICIDES. Apply when the majority of the grass weeds are in the 2- to 3-leaf stage. Do not apply if rain is expected within an hour of application. Delay other postemergence herbicide applications until at least 4 days after the diclofop-methyl application.
Emerged annual weeds	metribuzin SENCOR (500 g/L) or LEXONE (75 DF)	0.6 to 1.10 kg/ha 1.1 to 2.25 L/ha 0.8 to 1.5 kg/ha	Apply early postemergence soon after emergence of the crop before weeds are 4 cm high. Do not use postemergence on red skinned varieties or on potatoes grown for the early market or on the variety Shepody. DO NOT USE ON MUCK SOIL as a residue may injure vegetable crops sown the following season.

SPINACH

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating grasses	cycloate RO-NEET (720 g/L)	3.4 kg/ha 4.75 L/ha	Preplant incorporated in 150 to 300 L water per hectare on mineral soils only. Cycloate should be applied to a dry soil surface before planting and incorporated within 10 minutes with a double disk. A second incorporation at right angles in tandem with a harrow should follow as soon as possible. Use the lower rate on sandy soils.

Germinating annuals	chlorpropham CIPC (480 g/L)	1.3 to 5.0 kg/ha 2.73 to 10.0 L/ha	Preemergence in 150 to 300 L water per hectare on mineral soils only. Chlorpropham should be used at higher rates during warm weather between May 1 to October 15 on heavy soils. Use lower rates during cool season between October 15 to May 1 and on sandy loam soils.

TABLE TURNIPS (RUTABAGA)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses and some control of pigweed and lamb's-quarters.	trifluralin TREFLAN (545 g/L)	0.8 to 1.1 kg/ha 1.5 to 2.1 kg/ha	Apply in 150 to 300 L water per hectare, preplant incorporated on mineral soils only. DO NOT use on muck soils. Incorporation should be done in two directions 8 to 10 cm deep with the first incorporation as soon as possible but may be delayed up to 8 hours if necessary without any loss of activity. The second incorporation may be delayed if desired. Use higher rate on clay soils and lower rate on sandy soils. Cultivation for escaped broadleaf weeds should begin before they have reached the 3- to 4-leaf stage.

TOMATOES

Note: All treatments should be applied in 150 to 300 L water per hectare unless otherwise specified.

Weed control in tomatoes usually consists of a combination of chemical weed control and cultivation. Crop rotation is also beneficial in the control of weeds. Cultivation should be shallow to prevent bringing untreated soil to the surface which may result in another flush of weeds. When tomatoes are grown on raised beds and beds are reshaped during the course of the season, it may be necessary or useful to apply another herbicide treatment to areas between the rows to prevent a new weed infestation from interfering with harvesting. Do not exceed the total recommended rate per season of any herbicide applied more than once per year.

Band treatment of herbicides over the row will reduce the cost by one-half to two-thirds depending on the width of the band compared to the row spacing. Shallow inter-row cultivation will be required for weed control between the rows.

Perennial weeds may be partially controlled by cultivation. Controlling them in crops other than tomatoes when grown in rotation is the best approach to perennial weed control. Perennials are easily spread with cultivators or tillage equipment. Areas of perennial weeds are best tilled last. Machinery sanitation is important when moving from one field to another.

TRANSPLANTED TOMATOES

Preplant Incorporated

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses and some broadleaf weeds such as lamb's quarters and pigweed including triazine resistant species.	trifluralin TREFLAN (545 g/L)	0.60 to 1.1 kg/ha 1.1 to 2.1 L/ha	Preplant incorporate with a double disk (7- 10 km/hr) or S-tyne vibrating shank cultivator (10-13 km/hr) to a depth of 10 cm. Immediate incorporation is recommended, however delay of incorporation up to 8 hours after application, if necessary, will not likely result in any loss of activity. The second incorporation is preferably at right angles to the first. Use lower rates for sandy soils and increasing rates for loam to clay soils. Cool wet weather conditions may cause stunting of tomato transplants but yield is not usually affected. Effective on mineral soils but poor activity on highly organic soils (muck, peat).
Germinating annual grasses, some annual broadleaf weeds and nutsedge	pebulate TILLAM (720 g/L)	4.50 to 6.70 kg/ha 6.25 to 9.25 L/ha	Apply to a dry soil surface and incorporate immediately (see incorporation instructions for trifluralin above).

After Transplants Established

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses and broadleaf weeds	chloramben granular AMIBEN (10G)	4.5 kg/ha 45 kg/ha	Apply 2 weeks after transplanting when tomato plants are established but preemergence to weeds. Control weed escapes with cultivation. Do not apply granular chloramben to wet tomato foliage. Mustards and cocklebur are not controlled. A rainfall or irrigation within 7 to 10 days after application is required to activate the herbicide.
Germinating annual grasses and some broadleaf weeds	diphenamid ENIDE (50WP)	4.5 to 6.75 kg/ha 9.0 to 13.50 kg/ha	Apply soon after transplanting but preemergence to weeds. Soil residues have caused damage to fall seeded wheat or rye. Banding the treatment, fall plowing, adequate rainfall and higher temperatures will assist in reducing diphenamid residues.

Postemergence

Germinating and emerged annual grasses and broadleaf weeds	metribuzin[1] SENCOR (500 g/L) LEXONE (480 g/L)	0.30 to 0.85 kg/ha 0.55 to 1.70 L/ha 0.6 to 1.8 L/ha	Use in processing tomatoes only. Apply before weeds exceed 5 cm tall. Direct spray to bottom one-third of tomato plants to reduce risk of crop injury. Apply 3 weeks after transplanting when tomato plants are established. Avoid application when crop is under stress due to cool, wet, cloudy weather or excessively hot temperatures. Some tomato varieties are more sensitive than others. Use lower rates on sandy soils, higher rates on clay soils.

Preplant Incorporated

Germinating and emerged annual grasses and broadleaf weeds	trifluralin TREFLAN (545 g/L) followed by metribuzin[1] SENCOR (500 g/L) or LEXONE (480 g/L)	0.60 to 1.10 kg/ha 1.1 to 2.1 L/ha 0.30 to 0.85 kg/ha 0.55 to 1.7 L/ha 0.6 to 1.8 L/ha	Preplant incorporate trifluralin. Then follow-up with a postemergence application of metribuzin. See instructions above for both herbicides.

Preemergence And Postemergence

Germinating and emerged annual grasses and broadleaf weeds	chloramben AMIBEN (10G) followed by metribuzin[1] SENCOR (500 g/L) or LEXONE (480 g/L)	4.5 kg/ha 45 kg/ha followed by 0.30 to 0.85 kg/ha 0.55 to 1.7 L/ha 0.6 to 1.8 L/ha	Apply chloramben granular to established tomato transplants but preemergence to weeds, then control escaped weeds with metribuzin applied postemergence to crop and weeds. See instructions for chloramben and metribuzin above.
	diphenamid ENIDE (50WP) followed by metribuzin[1] SENCOR (500 g/L) or LEXONE (480 g/L)	4.5 to 6.75 kg/ha 9 to 13.5 kg/ha followed by 0.3 to 0.85 kg/ha 0.55 to 1.7 L/ha 0.6 to 1.8 L/ha	Apply diphenamid preemergence to weeds shortly after tomatoes are transplanted then followed with a directed postemergence application of metribuzin. See instructions for diphenamid and metribuzin above.

FIELD SEEDED TOMATOES

Preemergence

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating annual grasses and some annual broadleaf weeds	diphenamid ENIDE (50WP)	4.50 to 6.75 kg/ha 9.0 to 13.5 kg/ha	Apply preemergence immediately after seeding. Rainfall is required to activate the herbicide. A shallow cultivation may be necessary to activate the herbicide in the absence of rainfall. Continued cultivation is required if annual broadleaf weeds are a problem.

ORCHARDS

APPLES

NOTE: Recommended rates per hectare refer to area actually treated with herbicide.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Most weeds and grasses	amino triazole/ammonium thiocyanate AMITROL-T (240 g/L) CYTROL (240 g/L)	3.25 kg/ha 13.5 L/ha	Use at the rate of 4.5 L (product)/300L water as a spot treatment on actively-growing weeds and grass under established apple tree. For grass and poison ivy control spray to wet all foliage. Keep spray off tree trunks as much as possible. DO NOT USE WITHIN 30 DAYS BEFORE HARVEST. CYTROL is registered under non-bearing apple trees only. May be combined with simazine or terbacil.
	amitrole/simazine (1:3) AMIZINE (60 WP)	2 kg/ha 7.7 kg/ha	Apply in 800 L water per hectare after weeds emerge but before fruit starts to form (before 90% petal fall). Should provide a fairly quick kill of existing weeds as well as leave a residue to prevent regrowth for most of the season.

	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply in early spring or preferably in the fall. 70 g CASORON 4 G applied to an area 2 X 2 m is equivalent to 175 kg per hectare. Use only under trees planted over one year. Do not use on light sandy soils.
	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L water per hectare or apply 55 mL in 10 L of water sprayed to wet weed foliage. More effective when applied on a dull cloudy day or in the evening. More than one treatment may be necessary during the season since paraquat leaves no residue on the soil. Direct spray to avoid contact with green bark of trees. Paraquat can be used in mixtures with simazine or terbacil to provide residual vegetation control as well as a quick knock- down.
	simazine* PRINCEP (80 WP) SIMADEX (500 g/L)	2.25 to 4.5 kg/ha 2.75 to 5.5 kg/ha 4.5 to 9.0 L/ha	Apply in 300 to 1000 L water per hectare. Use only under trees planted for one year or more. Use only once per season. Use higher rate on perennial grasses such as quack grass. Can be applied in a mixture with paraquat or applied before weed emergence.
	terbacil SINBAR (80 WP)	1.75 to 3.5 kg/ha 2.0 to 4.25 kg/ha	Apply in 1000 L water per hectare. Use lower rate on soils with 1 to 2% organic matter. DO NOT USE on coarse sandy soils and/or those with less than 1% organic matter. Use only under trees established for at least three years. Can be applied in a mixture with paraquat.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 to 5.5 kg/ha 5.5 to 11 L/ha	This commercial mixture can be used after weeds have emerged to provide quick "knock- down" of weeds as well as residual control for most of the growing season. Use only under trees established for at least one year. Use the lower rate on light sandy soils.
	linuron** LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9 kg/ha 10 L/ha	Apply in 400 to 600 L water per hectare. Use only under apple trees established at least 10 years.
Emerged annual and perennial weeds	glyphosate	Annual Weeds 0.85 to 1.25 kg/ha Quackgrass 1.70 to 2.50 kg/ha Other Perennials 2.5 to 4.25 kg/ha	Apply in 200 to 300 L of water per hectare. Apply to actively growing weeds as a directed spray. For quack grass control, apply when grass has at least four new leaves. Canada thistle should be at least in early bud, milkweed at the bud and bindweed at full flower for best results. Remove all suckers from base of trunks before application. Do not allow spray or drift to contact leaves or green bark of trees. Do not apply within 30 days before harvest. Use preemergence herbicide to provide residual control of weed seedlings.

APPLES (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	ROUNDUP (356 g/L)	Annual Weeds 2.25 to 3.5 L/ha Quackgrass 4.75 to 7 L/ha Other Perennials 7 to 12 L/ha	For site preparation, use a broadcast spray and spray to thoroughly wet foliage but not to run off. Allow at least 5 days before tillage. Trees may be planted without further delay.
Emerged grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	7.5 kg/ha 11 kg/ha 11 kg/ha	Use at the rate of 1.1 kg (product)/100 L water as a spot treatment on actively growing grasses. Spray to wet vegetation. Use only under apple trees established at least 4 years. Use only once per growing season.
	propyzamide KERB (50 WP)	2.25 kg/ha 4.5 kg/ha	Apply from late September to early November when soil temperatures are low but above freezing. High soil moisture increases effectiveness. Use only under apple trees established at least 1 year. 4.5 kg/ha is equivalent to 45 g/100 m^2.
Bindweed and other broadleaf perennials	MCPB TROPOTOX (400 g/L) MCPA/MCPB (1:15) TROPOTOX PLUS (400 g/L)	1.1 kg/ha acid 2.5 L/ha 1.1 kg/ha 2.5 L/ha	Apply in 180 to 1000 L water per hectare. Use as a directed spray under established trees as a spot treatment. Apply at low pressure as a coarse spray to wet leaves of bindweed, etc. Avoid contact with leaves, fruit, young growing shoots, suckers and green bark.

** SIMADEX (80 WP) equivalent rate is 2.75 to 5.5 kg/ha in 350 L water.*

** (PRINCEP NINE-T) equivalent rate is 2.5 to 5.0 kg/ha.*

***LOROX L (480g/L) equivalent rate is 9.5 kg/ha.*

PEACHES

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Most weeds and grasses	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply in the early spring or preferably in the fall. 70 g of CASORON 4 G applied to an area 2 x 2 m is equivalent to 175 kg/ha. Use only under trees planted over one year. Do not use on light, sandy soil.

	linuron* **LOROX (50 WP)** **AFOLAN F (450 g/L)**	4.5 kg/ha 9 kg/ha 10 L/ha	Apply in 400 to 600 L water per hectare as a directed spray before weeds are 12 cm high. Use only under peach trees established for over one year. Keep spray off leaves and green bark of trees.
	paraquat **GRAMOXONE (200 g/L)**	1.1 kg/ha 5.5 L/ha	Apply in 1000 L of water per hectare or apply 55 mL in 10 L water sprayed to wet weed foliage. More than one treatment may be necessary during season. Direct spray to avoid contact with green bark of trees. Under established peach trees, paraquat may be used as a tank mix with linuron or terbacil.
	terbacil **SINBAR (80 WP)**	1.75 to 3.5 kg/ha 2.0 to 4.25 kg/ha	Apply in 1000 L of water per hectare. Use lower rate on soils with 1 to 2% organic matter. DO NOT USE on coarse, sandy soils and/or those with less than 1% organic matter. Use only under trees established for at least three years. Can be applied in a mixture with paraquat.
Emerged annual and perennial weeds	glyphosate **ROUNDUP (356 g/L)**	See under APPLES (page 101) for rates and remarks.	

**LOROX 480 g/L equivalent rate is 9.5 L/ha.*

PEARS

WEEDS	Generic Name **TRADE NAME &** (Formulation)	Rate (Active) **RATE (PRODUCT)**	REMARKS
Most weeds and grasses	dichlobenil **CASORON (4 G)**	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply in early spring or preferably in the fall. 70 g of CASORON 4 G applied to an area 2 x 2 m is equivalent to 175 kg/ha. Use only under trees planted over one year. Do not use on light sandy soils.
	simazine* **PRINCEP (80 W)** **SIMADEX (500 g/L)**	2.25 to 4.5 kg/ha 2.75 to 5.5 kg/ha 4.5 to 9.0 L/ha	Apply in 300 to 1000 L of water per hectare. Use only under trees planted for one year or more. Use only once per season. Can be applied in a mixture with paraquat or applied before weed emergence.
	linuron** **LOROX (50 WP)** **AFOLAN F (450 g/L)**	4.5 kg/ha 9.0 kg/ha 10.0 L/ha	Apply in 400 to 600 L water per hectare. Use only under pear trees established at least 10 years.
	paraquat **GRAMOXONE (200 g/L)**	1.1 kg/ha 5.5 L/ha	Apply in 1000 L water per hectare or apply 55 mL in 10 L water sprayed to wet weed foliage. More effective when applied on a dull

PEARS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
			cloudy day or in the evening. More than one treatment may be necessary during the season. Direct spray to avoid contact with green bark of trees. Paraquat can be used in a mixture with simazine.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 to 5.5 kg/ha 5.5 to 11 L/ha	This commercial mixture can be used on emerged weeds and grass to provide a quick "knock-down" of weeds as well as residual control for most of the growing season. Use only under trees established or at least one year. Use the lower rate on sandy soils.
Emerged annual and perennial weeds	glyphosate ROUNDUP (356 g/L)	See under APPLES (page 101) for rates and remarks.	
Emerged grasses	dalapon DOWPON M (74 SP) BASFAPON (74 SP)	7.5 kg/ha 11 kg/ha 11 kg/ha	Use at the rate of 1.1 kg (product)/100 L water as a spot treatment on actively growing grasses. Spray to wet vegetation. Use only under pear trees established at least four years. Use only once per growing season.
	propyzamide KERB (50 WP)	2.2 kg/ha 4.5 kg/ha	Apply from late September to early November when soil temperatures are low but above freezing. High soil moisture increases effectiveness. Use only under pear trees established at least 1 year. 4.5 kg/ha is equivalent to 45 g/100 m^2.

** PRINCEP-NINE-T equivalent rate is 4.0 to 5.0 kg/ha*

** SIMADEX 80 WP equivalent rate is 4.5 to 5.5 kg/ha*

***LOROX L 480 g/L equivalent rate is 9.5 L/ha*

CHERRIES AND PLUMS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Most weeds and grasses	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply in the early spring or preferably in the fall. 70 g of CASORON 4 G applied to an area 2 x 2 m is equivalent to 175 kg/ha. Use only under trees planted over one year. Do not use on light, sandy soil.

	linuron* LOROX (50 WP) AFOLAN F (450 g/L)	4.5 kg/ha 9 kg/ha 10 L/ha	Apply in 400 to 600 L water per hectare as a directed spray before weeds are 12 cm high. Use only under cherry and plum trees established for ten years. Keep spray off leaves and green bark of trees.
	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L water per hectare or apply 55 mL in 10 L water sprayed to wet weed foliage. Direct spray to avoid contact with green bark of trees. More than one treatment may be necessary during season. Under cherry and plum trees established at least 10 years, linuron can be used as a tank mix with paraquat to provide residual weed control.
Emerged annual and perennial weeds	glyphosate ROUNDUP (356 g/L)	See under APPLES (page 101) for rate and remarks.	

**LOROX L 480 g/L equivalent rate is 9.5 L/ha.*

GRAPES

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Germinating weeds	diuron KARMEX (80 WP)	1.65 to 4.0 kg/ha 2.25 to 6.7 kg/ha	Apply in at least 300 L of water per hectare actually sprayed. Apply as a directed spray to a 1 m strip under vines. Where weed growth is heavy a rate of 4.5 kg/ha KARMEX (80 WP) is usually sufficient except on heavy clay soils or on soils with a high organic matter content. Then the rate should be increased to 6.7 kg/ha. A maintenance application of 2.25 kg/ha KARMEX (80 WP) should be sufficient if applied before weed seeds germinate. Use only in vineyards established for at least 3 years. Applications may be made in the spring or fall or both but total amount applied in one year should not exceed 4.5 kg/ha KARMEX (80 WP) except on heavy clay or high organic matter soils as noted above.
	simazine* PRINCEP (80 WP) SIMADEX (500 g/L)	3.6 to 4.5 kg/ha 4.5 to 5.5 kg/ha 7.2 to 9 L/ha	Apply in at least 300 L of water per hectare actually sprayed. Apply as a directed spray to a 1 m strip under the vines. Use only in vineyards established for at least 3 years. Established dandelions, field bindweed and quack grass will not be controlled. Should control plantain.
	dichlobenil CASORON (4 G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply in early spring or in fall. Apply only to dormant healthy vines which have been established for at least two full years. Apply in cool weather on moist soil.

GRAPES (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged weeds and grasses	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L water per hectare or apply 55 mL in 10 L water sprayed to wet weed foliage. Use as a directed spray to avoid spraying leaves and young bark of vines. Treatment is more effective if made on dull cloudy days or in the evening. Paraquat can be used in a tank-mix with diuron or simazine above.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 to 5.5 kg/ha 5.5 to 11 L/ha	Apply in 500 L of water per hectare. Use only in vineyards established for at least 3 years. See notes above for paraquat and simazine.
Bindweed, plantain and many broadleaf weeds and grasses	paraquat GRAMOXONE (200 g/L) Plus MCPB or MCPA/MCPB (1:15) TROPOTOX or TROPOTOX PLUS	1.1 kg/ha 5.5 L/ha plus 1.1 kg/ha 2.75 L/ha	Apply in 1000 L water per hectare or apply 55 mL GRAMOXONE plus 30 mL TROPOTOX in 10 L water per 100 m^2. Apply in late May or early June or for bindweed control, when bindweed starts to bloom. MCPB or MCPA/MCPB SPRAY OR DRIFT CAN INJURE GRAPES. Use only when necessary as a spot treatment. Use a hand sprayer or a hand-controlled want fitted with a shielded nozzle. Use a low pressure coarse spray and direct spray to avoid contact with leaves and stems of grape vines.
Quack grass, bindweed and many other emerged broadleaf weeds and grasses	glyphosate ROUNDUP (356 g/L)	Quackgrass 1.7 to 2.5 kg/ha Other Perennials 2.5 to 4.25 kg/ha Quackgrass 4.75 to 7.0 L/ha Other Perennials 7.0 to 12 L/ha	Apply in 200 to 300 L of water per hectare actually sprayed. Apply as a directed postemergence spray to control actively growing quack grass, bindweed and many other broadleaf and grassy perennial weeds. The higher rate is needed to control bindweed. Use preemergence herbicides to provide residual control of weeds seedlings. DIRECT SPRAY TO AVOID LEAVES AND GREEN STEMS OF GRAPEVINES. Do not use on vines less than 3 years old. For site preparation apply to actively growing weeds. Quack grass can be controlled with the lower rate if applied after it has at least four true leaves. Bindweed should be in full flower, milkweed at the bud stage and Canada thistle starting to flower for best results. Spray to thoroughly wet weeds but not to run off. Delay cultivation for at least 5 days after treatment. Grapes can be planted without further delay. Apply in the fall in cool weather on moist soil. Apply only to dormant healthy vines which have been established for at least two full years.
Quack grass, thistles, bindweed and perennial weeds	dichlobenil CASORON (4 G)	7 to 9 kg/ha 175 to 225 kg/ha	Apply in the fall in cool weather on moist soil. Apply only to dormant healthy vines that have been established at least two full years.

**PRINCEP-NINE-T equivalent rate is 4.0 to 5.0 kg/ha.*

**SIMADEX (80 WP) equivalent rate is 4.5 to 5.5 kg/ha.*

SMALL FRUIT

CURRANTS AND GOOSEBERRIES

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged weeds and grasses	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L of water per hectare or apply 55 mL in 10 L of water as a spot treatment, sprayed to wet weed foliage. Use as a directed spray when weeds are less than 15 cm high. Direct the spray to wet the weeds but avoid wetting the leaves or green bark of the bushes. Quack grass may require 2 or 3 applications during the season for control. Best results are obtained if the application is made on a dull cloudy day or in the evening.

RASPBERRIES AND BLACKBERRIES

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged broadleaf weeds	2,4-D Amine 2,4-D (500 g/L)*	0.55 kg/ha 1.0 L/ha	Apply in 100 to 200 L of water per hectare actually sprayed. Do not spray when plants are in bloom. Keep spray off new shoots as much as possible. Spot spraying at a rate equivalent to 1 kg/ha may be necessary to control established dandelions and other broadleaf weeds.
Germinating weeds and grasses	simazine** PRINCEP (80 WP) SIMADEX (500 g/L)	1.8 to 2.25 kg/ha 2.25 to 2.75 kg/ha 3.6 to 4.5 L/ha	Apply in 300 to 1000 L of water per hectare actually sprayed. Apply as a directed spray early in the spring before the weeds emerge. Keep spray off young shoots. Do not use in first year plantings. Do not exceed recommended rate.
Emerged weeds and grasses	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Apply in 1000 L of water per hectare or apply 55 mL in 10 L water sprayed to wet weed foliage. Direct spray at base of canes in the spring before new shoots emerge or in the fall when canes are mature. This material is more effective when applied on dull days or in the evening.
	paraquat/simazine (1:4) TERRAKLENE (500 g/L)	2.75 kg/ha 5.5 L/ha	This commercial mixture can be used on established plantings only to control emerged weeds and grasses and to provide residual control. Do not spray young raspberry shoots. See notes concerning simazine and paraquat above.

RASPBERRIES and BLACKBERRIES (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged grasses including quack grass	dalapon DOWPON M (74 SP) DALAPON (74 SP) BASFAPON (74 SP)	0.75 kg/100 L water 1.0 kg/100 L water	Apply as a spot treatment to actively growing grasses. Spray to wet grass foliage. Apply early in the spring or in the fall. Direct spray to avoid new shoots.
Quack grass, perennial and annual weeds	dichlobenil CASORON (4 G)	7.0 kg/ha 175 kg/ha	Apply on established raspberry plantings in late fall. Do not cultivate or work into the soil. DO NOT APPLY IN THE SPRING as injury may result.

** Additional formulations are available. Use rates to give comparable amounts of active ingredient. (See Table 1.)*

***PRINCEP-NINE-T equivalent rate is 2.0 to 2.5 kg/ha.*

***SIMADEX (80 WP) equivalent rate is 2.25 to 2.75 kg/ha.*

STRAWBERRIES

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Planting Year 2 to 6 weeks after planting.			
Germinating weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.75 to 14.25 kg/ha	Apply preemergence to the weeds or following a clean cultivation. Shallow cultivation to incorporate chemical into soil surface may improve weed control. Do not apply more than three applications during the planting year.
	diphenamid ENIDE (50 WP)	4.5 to 6.75 kg/ha 9 to 13.5 kg/ha	Apply preemergence to the weeds or following a clean cultivation. Shallow cultivation to incorporate chemical into soil surface may improve weed control. Irrigation with 12 — 25 mm of water immediately prior to or after application will improve weed control if soil is dry.
Broadleaf annual seedlings	chloroxuron TENORAN (50 WP)	4.5 to 5.5 kg/ha 9 to 11 kg/ha	Apply in at least 300 L of water per hectare before weeds are 3 — 5 cm high. Do not use more than three applications during the planting year.

	2,4-D amine 2,4-D (500 g/L)*	0.55 kg/ha 1.1 L/ha	Apply in 100 to 200 L of water per hectare. Use low pressure and a coarse spray to minimize risk of spray drift to susceptible crops. Do not use after early runners start to root in June, or between mid-August and fall dormancy when flower buds are developing for next year's crop.

Planting Year 4 to 6 weeks after planting.

Germinating and seedling weeds	terbacil SINBAR (80 WP)	220 to 440 g/ha 275 to 550 g/ha	Apply in at least 300 L of water per hectare when mother plants are well established but before runnering becomes extensive and new runner plants are rooting. Apply preemergence or early postemergence to the weeds. Use lower rate on sandy soils low in organic matter and on sensitive varieties such as Early Dawn, Midway, Micmac and Bounty. Weak or diseased plants may be severely injured. Accurate calibration of sprayer is essential to avoid crop injury. Do not overlap spray swaths. Shallow cultivation can be done to train runners and control weed escapes without destroying the activity of terbacil.

**Additional formulations are available. Use rates to give comparable amounts of active ingredient. (See Table 1.)*

Late Summer and Fall — Planting and harvesting years

Germinating weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.75 to 14.25 kg/ha	Apply preemergence to the weeds, following clean cultivation.
Chickweed and small broadleafs	chloroxuron TENORAN (50 WP)	4.5 to 5.5 kg/ha 9 to 11 kg/ha	Apply in at least 300 L of water per hectare, early postemergence to weeds or to growing chickweed.
Germinating and seedling weeds	terbacil SINBAR (80 WP)	150 to 220 g/ha 180 to 275 g/ha	Apply in at least 300 L of water per hectare, preemergence or early postemergence to the weeds. See remarks on terbacil above.

Late Fall — Planting and harvesting years

Wheat, winter annuals and weeds germinating in early spring	terbacil SINBAR (80 WP)	550 to 700 g/ha 675 to 850 g/ha	Apply in at least 300 L of water per hectare just prior to mulching. Use low rate where it is planned to use terbacil again in the spring.

STRAWBERRIES (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Spring — Harvesting Years			
Seedling weeds	chloroxuron TENORAN (50 WP)	4.5 to 5.5 kg/ha 9 to 11 kg/ha	Apply in at least 300 L of water per hectare early postemergence to the weeds or to growing chickweed. DO NOT APPLY within 60 days of harvest.
Germinating weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.75 to 14.25 kg/ha	Apply preemergence to the weeds, immediately after removing the mulch.
Germinating and seedling weeds	terbacil SINBAR (80 WP)	220 to 280 g/ha 275 to 350 g/ha	Apply in at least 300 L of water per hectare immediately after mulch is removed. Strawberry plants that have made weak yellow growth under the mulch may be severely injured.
After-Harvest Renovation			
Dandelions and other broadleaf weeds	2,4-D Amine 2,4-D (500 g/L)*	1.1 kg/ha 2.2 L/ha	Apply after harvest but before mowing to control dandelions and other broadleaf perennials. Delay mowing for a few days after application. Do not apply 2,4-D between mid- August and fall dormancy because of its possible effect on flower bud formation. Veestar is more sensitive to 2,4-D than Redcoat.
Germinating weeds	chlorthal dimethyl DACTHAL (75 WP)	9 to 11 kg/ha 11.75 to 14.25 kg/ha	Apply preemergence to the weeds after mowing and narrowing the rows.
Seedling weeds	chloroxuran TENORAN (50 WP)	4.5 to 5.5 kg/ha 9 to 11 kg/ha	Apply in at least 300 L of water per hectare early postemergence to the weeds.
Germinating and seedling weeds	terbacil SINBAR (80 WP)	550 to 700 g/ha 675 to 850 g/ha	Apply in at least 300 L of water per hectare preemergence or early postemergence to the weeds. Terbacil suppresses quack grass. If 2,4-D was used prior to mowing, delay applying terbacil for at least 2 weeks.

**Additional formulations are available. Use rates to give comparable amounts of active ingredient. (See Table 1.)*

CAUTION: Residues high enough to harm some crops can persist in the soil for over a year after using TERBACIL. Residues are likely to be higher on heavier soil types.

OTHER HORTICULTURAL USES

ANNUAL FLOWERS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Seedling annuals and germinating seeds	chloramben ORNAMENTAL WEEDER (4G) WEEDONE GARDEN WEEDER (1.2G)	4.5 kg/ha 1.1 kg/100 m^2 3.7 kg/100 m^2	Chloramben is applied as a granular formulation on weed-free areas about established plants. Check label for list of tolerant ornamental plants.
	chlorthal dimethyl DACTHAL (75 WP) DACTHAL (5G)	6.75 to 12.5 kg/ha 9 to 16.5 kg/ha 1.4 to 2.5 kg/100 m^2	Apply the wettable powder in 150 to 300 L water per hectare before weed emergence. Controls annual grasses and a number of broadleaf annual weeds. Use only about established transplants.
	EPTC EPTAM (2.3G)	5.75 to 6.9 kg/ha 250 to 300 kg/ha	Use on mineral soils only. Use the granular formulation at the lower rate after the plants are established. Apply when the leaves are dry and use sprinkler irrigation to incorporate.
	trifluralin TREFLAN (545 g/L)	0.6 to 1.1 kg/ha 1.2 to 2.1 L/ha	Trifluralin must be incorporated thoroughly to a depth of 8 to 13 cm before transplanting. Do not use for seeded annuals. Check label for list of tolerant species.

DRIVEWAYS, PATIOS AND PATHS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Many broadleaf weeds and grass	ammonium sulfamate POISON-IVY & BRUSH KILLER (500 g/L)	0.15 kg in 4.5 L water 0.3 kg in 4.5 L water	Ammonium sulfamate is not selective, that is, it will kill all plants on which it is sprayed. Spray enough to wet weed foliage. Wash all spray equipment immediately after use as this chemical is very corrosive.

DRIVEWAYS, PATIOS AND PATHS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	paraquat GRAMOXONE (200 g/L)	0.6 to 1.1 kg/ha 3 to 5.5 L/ha	Apply in 275 L water per hectare. This chemical is not available to the home gardener but can be used by nurserymen, landscape contractors and farmers. It should be applied as a directed spray to wet the leaves and green bark of shrubs and other garden plants. Better results are usually obtained if application is made on a dull or cloudy day, or in the evening. For spot treatments use 30 mL of product in 10 L water per 100 m^2.
	paraquat WEEDRITE or WEED-BAN	Follow directions on label.	This product is packaged in small quantities for the home garden trade. The granules are readily dissolved in water so that application can be made with a watering can or garden sprayer. It is used as a "chemical mower." Use low pressure and a coarse spray to prevent drift onto lawns, flowers, vegetables and green leaves of other desirable plants. See note above.

GLADIOLI

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Seedling annuals and germinating seeds	chlorthal dimethyl DACTHAL (75 WP) DACTHAL (5G)	6.75 to 12.5 kg/ha 9 to 16.5 kg/ha 1.4 to 2.5 kg/100m^2	Apply preemergence for annual grass control.
	diuron KARMEX (80 WP)	0.9 to 1.75 kg/ha 1 to 2 kg/ha	Apply preemergence in at least 200 L water per hectare.
	linuron LOROX, AFOLAN (50 WP)	1.75 to 3.25 kg/ha 3.5 to 6.5 kg/ha	Use preemergence in 250 to 400 L water per hectare. Do not use on small corms. Any gladioli shoots exposed should be covered with soil.
	chloramben ORNAMENTAL WEEDER (4G) WEEDONE GARDEN WEEDER (1.2 G)	4.5 kg/ha 1.1 kg/100 m^2 3.7 kg/100 m^2	These granular formulations are available for the home gardener.

	chlorpropham CIPC (480 g/L) CIPC (20G)	5.5 kg/ha 11.6 L/ha 27.5 kg/ha or 275 g/100 m²	May be applied either pre- or postemergence to the gladioli. When used postemergence apply as a directed spray or use the granular formulation. Particularly effective against purslane. Apply after a clean cultivation when the soil is moist in 200 to 400 L per hectare.

IRIS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Seedling annuals and germinating seeds	diphenamid ENIDE (WP 50)	4.5 to 6.75 kg/ha 9 to 13.5 kg/ha	Apply in late fall or soon after flowering.
	chloramben ORNAMENTAL WEEDER (4G) WEEDONE GARDEN WEEDER (1.2 G)	4.5 kg/ha 1.1 kg/10 m² 3.7 kg/10 m²	Granular formulations suitable for the home garden trade. Apply after a clean cultivation when the leaves of the iris plants are dry.

LAWNS, PARKS AND GOLF COURSES

Vigorous growth of an adapted grass is the key to keeping lawn areas free of weeds. Proper lawn maintenance with the application of fertilizers is essential. The reader is referred to publications on this subject from both Agriculture Canada and the Ontario Ministry of Agriculture and Food. (See p. 149.) The 2,4-D spray is most effective in the spring, or in September when the weeds are growing well. The treatment will generally thin Dutch clover in the lawn. Mecoprop, dichlorprop, and dicamba will control a number of weeds resistant to 2,4-D. As with 2,4-D, a thorough wetting of the weed foliage is emphasized. Mecoprop, dichlorprop and dicamba are also sold in mixtures with 2,4-D. Mecoprop is safer to use on bent grass than 2,4-D.

Mixtures containing dicamba should not be used close to shrubs, etc., at rates above 425 g (active) per hectare. Prepared mixtures of this chemical and 2,4-D are effective on a wide range of lawn weed species, including knotweed which is resistant to most other herbicides except when very young. After seeding new turf, many annual weeds may emerge before the grass seedlings are up. If these young weeds are not controlled they will shade and eventually crowd out much of the grass population. Mowing with the mower set to cut as high as possible will eliminate many such weeds. If they are extremely thick, 2,4-D at one-half the usual strength (12 mL to 8 L water per 100 m²) or mecoprop (12 mL to 4 L water per 100 m²) can be used — but not before the grass has been up at least 4 weeks.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Dandelions, plantains and many broadleaf weeds	2,4-D amine	Follow manufacturers' directions	

LAWNS, PARKS AND GOLF COURSES (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Chickweeds, clovers, black medick, and other 2,4-D resistant weeds, including knotweed when young	mecoprop dichlorprop	1.1 kg in 400 L water/ha	
	2,4-D/mecoprop 2,4-D/dicamba 2,4-D/dichlorprop 2,4-D/mecoprop/dicamba	Follow manufacturers' directions	
WARNING — Since lawns are generally associated with a wide range of ornamentals and flowers that are susceptible to 2,4-D, dichlorprop, dicamba or mecoprop, particular care must be taken in the application of these chemicals.			
Crabgrass	bensulide	11 to 16.5 kg/ha or 110 to 165 g/100 m^2	Apply before crabgrass emergence in early spring, or in fall to established turf. Use only the higher rate for fall application.
	BETASAN (480 g/L) PREFAR (480 g/L) PRE-SAN (480 g/L) BETASAN (12.5% Gr)	23.1 L to 34.6 L/ha or 230 mL to 345 mL/100 m^2 88 to 132 kg/ha or 0.9 to 1.3 kg/100 m^2	
	chlorthal dimethyl	11 to 16.5 kg/ha or 110 to 165 g/100 m^2	See note above.
	DACTHAL (75 WP) DACTHAL (2.3% or 5% Gr)*	14.5 to 22 kg/ha or 145 to 220 g/100 m^2	
	siduron TUPERSAN (50 WP)	9 to 13.5 kg/ha 18 to 27 kg/ha	Crabgrass may be controlled in a newly seeded area by applying siduron (TUPERSAN) at 6.75 kg (active) per hectare. This chemical must be applied after seeding but preemergence to the crabgrass seedlings. Apply only in early spring.
	trifluralin TREFLAN (545 g/L) TREFLAN (1.4% Gr)	1.75 to 2.25 kg/ha 3.2 to 4.1 kg/ha 120 to 140 kg/ha	Follow manufacturers' instructions. Apply only in early spring.

Annual bluegrass (Poa annua)	bensulide	13.5 to 16.5 kg/ha or 135 to 165 g/100 m^2	Repeated treatments will be required. Reseeding the area will not be possible for one year following treatment.
	BETASAN, PREFAR or PRE-SAN (480 g/L)	28.4 to 34.6 L/ha or 280 to 345 mL/100m^2	
	BETASAN (12.5% Gr)	108 to 132 kg/ha or 1 to 1.3 kg/100 m^2	
	chlorthal-dimethyl (see above)	11 to 16.5 kg/ha or 110 to 165 g/100 m^2	See note above.

**DACTHAL 2.3% Gr use 4.8 to 7.2 kg/100 m*^{2}; 5% Gr use 2.2 to 3.3 kg/100 m^2.

TURFGRASS RENOVATION

The turf to be renovated should be mowed and thoroughly raked to remove all dead and cut vegetation. Apply paraquat (GRAMOXONE) at a rate of 2.0 kg (active) or 10 L (product) in 1,000 L water per hectare. For smaller areas, use 100 mL of product in 10 L water per 100 m^2. This treatment will "burn off" all emerged vegetation. When the old turf is dead, rotovate top 5 cm to cover dead grass, rake the surface to prepare seedbed and reseed.

Glyphosate (ROUNDUP) at 1.7 to 2.5 kg (active) or 4.75 to 7.0 L/ha (product) in 200 to 300 L water per hectare after omitting at least one regular mowing. Tillage should be delayed 7 days after application to allow for proper translocation into underground plant parts. Direct seeding into the killed turf (no tillage) may be carried out.

TURFGRASS RETARDATION

Reduction in grass growth may be brought about by treatment with maleic hydrazide (SLOGRO). Mefluidide (EMBARK 1.5S) also is recommended for grass growth suppression and control of seedhead formation. With all three chemicals, manufacturers' directions should be followed carefully.

These chemicals are recommended for use in areas where mowing and trimming are difficult and where a lawn-like appearance is not necessary. Temporary discoloration may result. Thus, the chemicals are recommended primarily for rough areas on golf courses, along fences or on steep banks. They are NOT recommended for use on home lawns.

Treatments should be applied in the spring at about the time the grass is starting to grow actively. Some control of broadleaf weeds may also be obtained from these chemicals, but treatment with 2,4-D and/or related herbicides will probably be required to give satisfactory weed control.

TURFGRASS ESTABLISHMENT

When it is desired to establish turfgrass in areas that are heavily infested with weeds such as quack grass, the area should be treated with gylphosate ROUNDUP prior to the preparation of the seedbed.

Use glyphosate (ROUNDUP) at 1.7 to 2.5 kg (active) or 3.7 to 5.5 L/ha (product) in 200 to 300 L water applied postemergence when quack grass is actively growing and has at least four leaves. Allow 7 or more days after application before tillage. For maximum quack grass control a repeat treatment may be necessary before grass establishment. If retreatment is necessary, wait until quack grass has reached the 3- to 4-leaf stage.

For other perennial weeds follow label instructions for proper rate and stage of growth.

WOODY NURSERY STOCK

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Seedling annuals and germinating seeds	chlorpropham CIPC (20G)	6.8 to 11 kg/ha 34 to 55 kg/ha	Apply the granular formulation after a clean cultivation when the soil is moist.
	chlorthal dimethyl DACTHAL (75 WP)	9 to 16.5 kg/ha 12 to 22 kg/ha	Apply preemergence for annual weed control.
	diphenamid ENIDE (50 WP)	4.5 to 9 kg/ha 9 to 18 kg/ha	Apply in the fall directly over established nursery stock. Apply to clean cultivated land as established weeds are not controlled. Should control many winter annual and annual weeds through the following spring.
	EPTC EPTAM (2.3G)	6 kg/ha 0.3 kg/10m^2	Apply to a dry soil surface and incorporate immediately with a heavy rake or cultivator.
	chloramben ORNAMENTAL WEEDER (4G) WEEDONE GARDEN WEEDER (1.2G)	4.5 kg/ha 1.1 kg/10m^2 3.7 kg/10m^2	Apply preemergence to the weeds, when the soil is warm and moist.
	simazine PRINCEP (80 WP) PRINCEP (90 SG)	2.25 to 3.38 kg/ha 2.8 to 4 kg/ha 2.5 to 3.75 kg/ha	Apply before weeds emerge on established plantings only. Nursery stock can be injured by a residue in the soil if this herbicide is used where stock is removed and replaced with another planting. This herbicide cannot be used about ornamental shrubs if the area is to be underplanted to ground cover or bedding plants.

	trifluralin TREFLAN (400 g/L)	0.6 to 1.1 kg/ha 1.5 to 2.75 kg/ha	Must be incorporated immediately after application after a clean cultivation. This treatment does not control ragweed, annual nightshade or mustards, and lady's-thumb may escape the treatment. Annual grass control is usually excellent.
Emerged annual weeds	glyphosate ROUNDUP (356 g/L)	0.8 to 1.25 kg/ha 2.2 to 3.5 L/ha	Apply to actively growing weeds. Do not allow spray to contact leaves or green bark of trees or shrubs.
Emerged perennial weeds	glyphosate ROUNDUP (356 g/L)	1.75 to 3.75 kg/ha 4.9 to 10.5 kg/ha	For the control of quack grass apply glyphosate at 1.75 to 2.50 kg/ha when the quack grass has at least 4 new leaves on each shoot. Canada thistle should be in the early bud stage, field bindweed in full flower, and milkweed at the bud stage of growth. Use 2.5 to 3.75 kg/ha in 200 to 400 L water per hectare as a directed spray in established nursery plantings.
Quack grass	dichlobenil CASORON (4G)	4.4 to 7.0 kg/ha 110 to 175 kg/ha	Apply in the late fall as a granular application. Check label for tolerant species.
	propyzamide KERB (50 WP)	1.75 kg/ha 3.50 kg/ha	Apply in the late fall when the soil temperature is low but above freezing. Soil moisture should be high. This herbicide is absorbed through the roots.
Grass and annual broadleaf weeds	paraquat GRAMOXONE (200 g/L)	1.1 kg/ha 5.5 L/ha	Used as a chemical mower and as such can be used several times during the year. Direct spray to avoid the leaves or green bark of nursery plants. Better results are obtained if applications are made in the evening or on dull cloudy days. For spot treatment use 25 mL product in 4 L water.

Warning: Certain types of woody nursery stock may be injured by the above herbicides. Check manufacturers' directions before use. CIPC (chlorpropham) should not be used on tree fruit nursery stock.

ERADICATING PERSISTENT PERENNIALS OR SHRUBS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Shrubs or herbaceous perennials	ammonium sulfamate POISON-IVY KILLER	30 mL per 100 m^2 60 mL per 100 m^2	The treatment with ammonium sulfamate is useful in handling persistent weeds, perennials that have become too aggressive, or shrubs such as lilacs, in garden areas. The chemical at the above rate will render the soil barren for about one season. However, it will break down in time, and the soil fertility will not be impaired.

ERADICATING PERSISTENT PERENNIALS OR SHRUBS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
			Damage may occur to desirable trees or other plants with roots that enter the treated area, or to plants located in lower portions of the garden onto which the chemical has been washed. Due precautions should be taken.

SEEDBEDS AND POTTING SOIL

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Seeds of most weeds	dazomet BASAMID (98 G)	0.39 kg/10 m^2 0.4 kg/ 10 m^2 for potting soil 0.3 kg/ 10 m^2 for liner beds	For potting soil, dazomet should be spread over a 25 cm layer of soil. Water immediately after treatment. Incorporate into soil and cover with a plastic sheet. Delay planting for 14 to 21 days or longer if weather is cool.
	methyl bromide DOWFUME MC2	0.5 kg/10m^2	A poisonous gas which must be applied under a gas-proof cover (usually plastic). Its use is subject to the Pesticides Act. It may be used by the grower on his own seedbeds but he must obtain a permit from the Ontario Ministry of the Environment each time it is used. The manufacturer's instructions must be followed and the seedbed or greenhouse aired thoroughly after the treatment period. If there is any question, the safety precautions in the Pesticides Act should be studied or inquiry made at the local office of the Ontario Ministry of Agriculture and Food or the Ontario Ministry of the Environment.
	dazomet MYLONE	0.6 kg/10 m^2	This herbicide is to be applied evenly over the prepared bed and irrigated with enough water to move the herbicide into the soil or incorporate. Seal surface with sprinkler irrigation.
	metam VAPAM	1.25 L/10 m^2	Apply as a drench to a soil that should be wet to a depth of at least 8 cm. Do not plant for 10 to 14 days or longer if the weather is cool.
	VORLEX	0.2 to 1 kg/10 m^2	A liquid soil fumigant which is injected into the prepared seedbed by means of special applicators.

SPECIAL METHODS OF WEED CONTROL

Site Preparation

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Quack grass, bindweed and many emerged broadleaf weeds and grass	glyphosate ROUNDUP (356 g/L)	1.7 to 4.25 kg/ha 4.75 to 12.0 L/ha	Glyphosate can be applied on actively growing weeds in spring or fall before transplanting grapes, apples, pears, stone fruit or ornamental nursery stock. Delay cultivation 5 or more days after application. Planting can take place without further delay. Crops not listed on the label may be planted one year after treatment. Potatoes can be planted in the spring following a fall application to control quack grass, etc. Consult label for specific weeds and rates.

STALE SEEDBED AND INTER-ROW WEEDING

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	paraquat or diquat GRAMOXONE or REGLONE (200 g/L)	0.6 to 1.1 kg/ha 3 to 5.5 L/ha	One of these herbicides may be used to kill emerged weeds on a prepared seedbed before the crop seed is sown. Check label for list of crops for which this technique is registered. In inter-row weeding special low pressure equipment is used to apply the herbicide on emerged weeds without contact with leaves of the crop plants. For small areas apply 30 mL product in 10 L water per $10m^2$.
	paraquat/diquat WEEDRITE, WEED-BAN	See label.	DOMESTIC — Soluble granular formulation for home gardener use. Check label rate.

ROADSIDES AND NON-CROP AREAS

Fencerows and Farm Areas

In agricultural areas, weeds growing in fencerows, around buildings and on roadsides are sources of potential weed infestation to other parts of a farm. In addition, brush and weeds around fields harbor insects, diseases, and other pests that may be detrimental to farming operations, or shrubs like wild cherry may be possible sources of livestock poisoning. Farmers may also wish to reclaim land on which willows or brush have encroached.

It is also important to keep drainage ditches and farm ponds free of troublesome aquatic vegetation.

Roadsides, Rights-of-way and Waste Places

Road maintenance personnel are interested in controlling weeds and brush to reduce the cost of winter snow-removal programs. Low vegetation will also give the road-user a clear view of other vehicles, animals, children, and other hazards. It is important to prevent brush encroachment onto the roadway proper, to keep the drainage ditches open to prevent flooding, and to minimize the fire hazard of tall dry vegetation in late summer. A grass cover also prevents soil erosion much better than weeds.

In some situations (i.e., hard-to-mow areas) chemical growth retardants can be used to reduce grass growth.

Both railway and power-supply authorities are concerned with maintaining safe and accessible rights-of-way by controlling growth of weeds and brush.

In certain areas (beneath guide rails, in storage yards, and under fences at road intersections), it may be advantageous to completely kill all vegetation for a longer period of time. Chemicals and suggestions for their use in this way are presented in the section on "Long-term Total Vegetation Control."

In roadside and right-of-way spraying, for weed control or brush control, precautions should always be taken to minimize herbicide drift. It is advisable to inspect or monitor each roadside just prior to spraying to locate susceptible crops, water-crossings and other sensitive areas. Appropriate "shut off" and "turn on" points should be marked so these areas can be avoided during the actual spraying operation.

ROADSIDE WEED CONTROL

The main objectives of a weed control program for roadsides are: (1) to control tall growing weeds so that mowing costs can be minimized; (2) to control weeds that may infest adjacent land by wind dispersal of seed; (3) to maintain an attractive grass cover that will minimize erosion problems; (4) to prevent buildup of excessive vegetation that can become a fire hazard in late summer or complicate snow removal in winter, and most importantly (5) to ensure highway safety for the travelling public. Most broadleaf weeds are susceptible to early summer applications of 2,4-D and related herbicides (Table 6). However, many weeds are not effectively controlled by 2,4-D mixtures and these resistant weeds can become an increasing problem unless other herbicides are used. The use of spot treatments with non-selective chemicals that may temporarily injure the grass may be justified in some cases to control isolated but dense patches of difficult weeds before they spread and become a problem over a large area.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Annual broadleaf weeds in newly constructed areas and biennial or perennial broad leaves, susceptible to 2,4-D.	2,4-D*	1.1 kg/ha	Apply as the AMINE or LOW-VOLATILE ESTER in 200 to 300 L water per hectare in early summer. See Table 8 for weed susceptibilities to 2,4-D mixtures.

Most biennial and herbaceous perennial weeds	2,4-D/dichlorprop (1:1)** DIPHENOPROP (700 g/L)	2.25 to 3.25 kg/ha 3.2 to 4.6 kg/ha	Apply as the LOW-VOLATILE ESTER in 200 to 500 L water per hectare during early summer for most species.
	dicamba/2,4-D (1:2) DYCLEER 24 (600 g/L)	1.65 to 3.30 kg/ha 2.75 to 5.5 L/ha	Apply as the AMINE in 100 to 200 L water per hectare when weeds are actively growing.
Spot treatments for difficult weeds. Canada thistle, perennial sow-thistle	dicamba/2,4-D (1:2) DYCLEER 24 (600 g/L)	3.3 kg/ha 5.5 L/ha	Apply as the AMINE in late spring just prior to flowering, or apply to regrowth escaping other treatments in summer or fall.
	amitrole AMIZOL (50 SP) AMITROL (90 SP) amitrole-t AMITROL-T (240 g/L) CYTROL (240 g/L)	4.5 kg/ha 9.0 kg/ha 5 kg/ha 4.5 kg/ha 19 L/ha 19 L/ha	Apply in 500 to 1000 L of water per hectare when the thistles are in the head stage of growth. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.
	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7 to 12 L/ha	Apply in 200 to 300 L water per hectare when the thistles are in the bud to full flower stage. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.
Leafy and cypress spurge	tba TBA-4 GENERAL WEED KILLER (400 g/L)	10 to 20 kg/ha 25 to 50 L/ha	Apply in sufficient spray volume to thoroughly wet all foliage. Apply as a spot treatment only, grass cover may be removed for one season.
Field bindweed	dicamba DYCLEER (400 g/L) dicamba/2,4-D DYCLEER 24 (600 g/L)	0.6 kg/ha 1.5 L/ha 3.3 kg/ha 5.5 L/ha	Apply in mid-June or when flowering.
	2,4-D* NUMEROUS	1.1 kg/ha	Apply in mid-June when flowering and repeat in early September.
	amitrole AMIZOL (50 SP) or amitrole-t CYTROL (240 g/L) AMITROL-T (240 g/L)	80 g/10L 160 g/10L 80 g/10L 0.33 L/10L 0.33 L/10L	Apply sufficient spray to wet all foliage in early summer before flowering. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.

ROADSIDE WEED CONTROL (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7 to 12 L/ha	Apply in 200 to 300 L water per hectare when the field bindweed has reached full flower. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.
Milkweed	amitrole AMIZOL (50 SP) or amitrole-t CYTROL (240 g/L) AMITROL-T (240 g/L)	80 g/10L 160 g/10L 80 g/10L 0.33 L/10L 0.33 L/10L	Spray to wet in early summer before flowering. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.
	glyphosate ROUNDUP (356 g/L)	2.5 to 4.24 kg/ha 7 to 12 L/ha	Apply in 200 to 300 L water/ha to thoroughly wet all foliage when milkweed has at least reached the bud stage. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.

* *The commercial formulations of 2,4-D are too numerous for specific mention in this publication.*

***There are several commercial formulations of 2,4-D/dichlorprop, see Table 1.*

While it is important to control weeds on roadsides, it is absolutely essential to take precautions to avoid damage to non-target vegetation adjacent to the roadside or right-of-way.

REDUCTION OF HERBICIDAL DRIFT

In the application of herbicides, especially of the hormone type (2,4-D, mecoprop, dichlorprop, dicamba, etc.), sensitive crops (grapes, tomatoes, turnips, tobacco, beans, carrots, beets, fruit trees, ornamental plants and many others) beyond the area being sprayed can be damaged by vapor drift or spray drift. To reduce the danger of herbicidal drift:

1. Use only amine formulations when it is necessary to apply hormone-type herbicides near sensitive non-target plants.
2. Very slight spray drift with herbicides containing dicamba can be more damaging to soybeans and other crops than equivalent amounts of 2,4-D spray drift. There is also a possibility of dicamba vapor drift from treated plant foliage during high temperatures (in excess of 25°C) thus, use of dicamba-containing herbicides should be avoided near sensitive desirable plants.
3. Use the lowest pressure possible to apply the herbicide. This may mean the use of a dribble bar, vibrajet nozzle, Directa-spra nozzle, flood jet or more conventional nozzle tips.
4. Manufacturers' recommendations regarding nozzle spacing and height should be carefully followed. It may be necessary to mount nozzles on skids to keep them at a constant distance from the surface to be sprayed.
5. For roadside spraying, various spray additives, i.e. BIVERT PH, Norbak-60, or Nalco-Trol are available which may reduce spray drift by increasing the viscosity or density of the spray. These materials should be used following manufacturers' directions, and observing normal precautions (vehicle speed, wind velocity, proximity to sensitive crops, etc.).

WARNING: These methods and materials can reduce but do not eliminate herbicidal drift. In areas near sensitive crops, all normal precautions must be taken. It should be emphasized that extremely low, even invisible, amounts of spray drift can be very damaging to sensitive crops. In some cases, spraying during the growing season should not be considered.

ROADSIDE GRASS RETARDATION

Retardation of the growth of grasses and some broadleaf plants on roadsides and other rights-of-way can be achieved by spraying with chemical growth retardants.

Treatments should be applied in the spring when grass has started to grow actively. In Southern Ontario the best time is early to mid-May, depending on seasonal variations.

If the grass height is uneven, the area should be mowed before spraying to improve its appearance.

Fresh mowings and other debris should be removed before spraying so that the spray is not prevented from reaching the growing grass. No mowing should be done for at least 1 week after treatment.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Retardation of grasses	maleic hydrazide SLO-GRO (350 g/L)*	4.5 to 6.75 kg/ha 13 to 20 L/ha	Apply in 400 L water per hectare. The turf should be 3 or more years old and should be growing vigorously at the time of treatment. A slight yellowing of the grass may occur after application of maleic hydrazide. The growth of many weeds is not controlled by maleic hydrazide. The use of an amine salt of 2,4-D at the rate of 2.25 kg per hectare is therefore recommended. The two chemicals can be applied at the same time as a tank-mix.
	mefluidide EMBARK 150 S (150 g/L)	600 g/ha 4 L/ha	Mefluidide is recommended for grass growth suppression and seedhead control on roadsides, steep banks, and other rights-of- way. Mowing may be done up to one day before or 3 to 7 days after treatment to improve appearance. A separate herbicide application is usually necessary to control broadleaf weeds.

**Numerous other commercial formulations of maleic hydrazide are also available.*

WEED CONTROL IN DRY DITCHES

When ditches on roadsides, or in other locations, contain standing or moving water, herbicides should not be applied to emergent weeds without consulting the Ontario Ministry of the Environment regarding the need for a permit (See WEEDS IN AQUATIC ENVIRONMENT, page 136.) However, such permits are not normally necessary for the application of herbicides to control weeds adjacent to ditches or weeds in ditches when no water is present. But the following precautions should be taken:

1. Spray when ditch or stream contains little or no flowing water.
2. Avoid spraying directly onto water surface (violation of Pesticides Act, Water Resources Act).
3. Schedule spray programs so that extensive sections of stream bank or ditch bank are not sprayed at one time.
4. Work upstream rather than downstream along the stream bank or ditch bank.
5. Ascertain downstream water uses to avoid possible conflict with the rights of other landowners.

WEED CONTROL IN DRY DITCHES (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Cattails	amitrole AMIZOL (50 SP) AMITROL (90 SP)	9 to 11 kg/ha 18 to 22 L/ha 10 to 12 L/ha	Apply when cattails are actively growing in sufficient water (4000 L/ha or 50 L/100 m^2) to thoroughly wet all foliage.
	dalapon DOWPON M or BASFAPON (74 SP)	8 to 24 kg/ha 10 to 30 kg/ha 10 to 30 kg/ha	Apply in at least 1000 L of water per hectare after seed heads have formed.
	glyphosate ROUNDUP (356 g/L)	2.5 to 5 kg/ha 7 to 12 L/ha	Apply during mid- to late-flowering stage (mid-July to late August) when cattails are actively growing. For isolated spots use a 1% solution 1 L (product) in 100 L water and spray to wet all foliage, but not to the point of run- off.
	paraquat GRAMOXONE (200 g/L)	1.1 to 2.2 kg/ha 5 to 10 L/ha	Apply in 750 to 1000 L water per hectare when the seed heads are forming — usually late July or August.
Bulrushes	2,4-D*	2.25 kg/ha	Apply as the LOW-VOLATILE ESTER in 750 -1000 L of water per hectare.
Other weeds			See ROADSIDE WEED CONTROL, and Table 6 for the most effective treatments for species present.

**The commercial formulations of 2,4-D are too numerous for specific mention in this publication.*

SHORT-TERM TOTAL VEGETATION CONTROL

(Foliage Treatment Chemical Mowing)

Chemicals offer an alternative to mowing in areas where top-kill of low growing vegetation is desired. The chemicals listed below are first applied when the growth is about 15 cm high. Spray to runoff. Tall vegetation is more difficult to kill and can become an unsightly fire hazard when it dies.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Control of any emerged annual or perennial weeds	amitrole AMIZOL (50 SP) or AMITROL (90 SP) amitrole-t AMITROL-T (240 g/L) or CYTROL (240 g/L) glyphosate ROUNDUP (356 g/L)	4.5 to 6.5 kg/ha 9 to 13 L/ha 5 to 7 L/ha 4 kg/ha 11 L/ha 11 L/ha 1.8 to 2.5 kg/ha 5 to 7 L/ha	Amitrole, Amitrole-T, or glyphosate must be applied to actively growing foliage to be effective. Apply in sufficient water (200 to 400 L/ha) to thoroughly wet all foliage. With amitrole or amitrole-T, newly formed leaves turn white before the plants die. The appearance of foliage injury may be delayed during cool conditions. Regrowth may occur from freshly germinating plants or from underground portions of perennial weeds. The addition of bromacil at 1.75 kg/ha to amitrole treatments may help provide season-long control but combinations such as this should be avoided around useful trees.
Top-kill only of annual or perennial plants	paraquat GRAMOXONE (200 g/L) diquat REGLONE (200 g/L)	1.1 to 2.2 kg/ha 5.5 to 11 L/ha 1.1 to 2.2 kg/ha 5.5 to 11 L/ha	Diquat or paraquat should be used at the higher rates and in a high spray volume (1000 L/ha) for dense weed growth. For chemical mowing along roadsides and other areas where a scorch is desired, paraquat at 0.55 L/ha will be adequate. Diquat or paraquat may be applied as tank-mixes with atrazine or diuron where both immediate top-kill and residual control are desired. These combinations should not be applied near valuable trees or shrubs.
	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	70 kg/ha 140 L/ha	Apply in approximately 1000 L water per hectare. Thoroughly wet all foliage. Ammonium sulfamate is corrosive to metal, thus it is essential to thoroughly clean spray equipment after use.

LONG-TERM TOTAL VEGETATION CONTROL

(Bare Areas — Soil Sterilization)

It may be desirable to maintain certain areas completely free of vegetation. Usually two problems are involved. First, the existing vegetation must be destroyed — including the destruction of underground stems and roots of perennials. Second, the bare area thus produced must be maintained either by long-term soil sterilization or by foliage treatment of weed seedlings.

Some soil sterilants will kill existing vegetation. Others, while excellent for maintaining the bare area, may be used more economically if combined with another chemical to kill existing growth. If a mixed population of weeds is present, combinations of chemicals that will kill the different types may be used advantageously.

Uniform coverage with all chemicals is essential. Touch-up operations should be expected. as a single treatment will seldom give complete eradication.

It is usually found that two applications of the lower recommended rate, i.e. 5.5 to 11 kg per hectare, depending on the chemical used, spaced 6 to 12 months apart, give better results than one single application of the higher recommended rate.

The length of weed control obtained with soil sterilants will depend on several factors which include rainfall, soil type, weed type and amount applied. Control is usually maintained longer in heavier soil types, while in sandy soils and gravel areas the length of effective control is much less.

Care should be exercised when selecting a chemical to use on driveways because washing of the chemical onto nearby lawns and gardens may ocur. In situations where this may occur it is advisable to use one of the chemicals listed under "SHORT-TERM GENERAL VEGETATION CONTROL," or "DRIVEWAYS AND PATIOS."

LONG-TERM TOTAL VEGETATION CONTROL (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Non-selective control of all vegetation.	ammonium sulfamate WILSON'S POISON IVY AND BRUSH KILLER (500 g/L)	200 to 250 g/5L 400 to 500 g/5L water	
	amitrole/simazine AMIZINE (60WP)	13.4 kg/ha 22.5 kg/ha	
	bromacil HYVAR X (80WP) or HYVAR XL (240 g/L)	5.5 to 11 kg/ha 7.7 to 13.5 kg/ha 30 to 45 L/ha	Mullein is not adequately controlled by bromacil.
	bromacil/diuron (1:1) KROVAR (80WP)	10 to 15 kg/ha 14 to 18 kg/ha	
	diuron KARMEX (80WP)	11 to 44 kg/ha 14 to 55 kg/ha	Plantain is not adequately controlled by diuron.
	hexazinone VELPAR (90 SP)	4 to 8 kg/ha 4.5 to 9.0 kg/ha	
	prometone PROMETONE (240 g/L) or PROMETONE (80WP)	22 kg/ha 92 L/ha 28 kg/ha	
	simazine SIMMAPRIM (80WP) SIMADEX (500 g/L)	11 to 22 kg/ha 14 to 28 kg/ha 22 to 44 L/ha	Crabgrass is not adequately controlled on simazine-treated sites.
	Atrazine PRIMATOL (80WP)	11 to 22 kg/ha 14 to 28 kg/ha	Crabgrass is not adequately controlled on simazine-treated sites.
	simazine/atrazine ERAMOX (80WP)	11 to 22 kg/ha 150 to 300 g in 20 L WATER per 100 m^2	
	tebuthiuron SPIKE (80WP) SPIKE (5% G)	4.4 to 11 kg/ha 5.5 to 13 kg/ha 110 to 220 kg/ha	Field horsetail is not adequately controlled by tebuthiuron.

CAUTION: The above chemicals may sometimes be used to treat areas that are close to gardens, desirable trees, etc. Since these chemicals will kill any plant that they contact, special care and forethought must be used in their application. If the area (for example, a driveway) is higher than the nearby flower beds, the chemical may wash onto them with the first rain. If trees or shrubs are feeding under the treated area, the chemical may leach to their roots and cause injury.

PERENNIAL WEED CONTROL (NON-CROPLAND)

Perennial weeds are more difficult to control than annual weeds because regrowth occurs rapidly from underground parts after the top growth is removed by chemical or mechanical means. In non-crop land they pose a special problem because cultivation cannot be used for their control. Chemicals must kill the root system as well as the above-ground parts to give effective perennial weed control.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
All perennials, non-selective control	diuron KARMEX (80WP)	11 to 44 kg/ha 14 to 55 kg/ha	Apply in 1000 L water per ha.
	simazine SIMMAPRIM (80WP) SIMADEX (500 g/L)	11 to 22 kg/ha 14 to 28 kg/ha 22 to 44 kg/ha	Apply as a coarse spray. Follow the manufacturer's directions regarding agitation.
	atrazine PRIMATOL (80WP)	11 to 22 kg/ha 14 to 28 kg/ha	Apply as a coarse spray. Follow the manufacturer's directions regarding agitation.
	bromacil HYVAR XL (240 g/L) or HYVAR X (80WP)	7.2 to 11 kg/ha 30 to 45 L/ha 9 to 14 kg/ha	
	amitrole/simazine AMIZINE (60WP)	14 kg/ha 23 kg/ha	Apply in 110 L water per hectare when weeds are actively growing.
	bromacil + diuron (1:1) KROVAR (80WP)	11 to 15 kg/ha 14 to 18 kg/ha	
2,4-D susceptible weeds	2,4-D*	1.1 to 1.8 kg/ha	Apply as the amine or low-volatile esters in 200 to 300 L water per hectare. See Table 8 for list of weed susceptibilities to 2,4-D and related chemicals.
Evergreens and brush (less than 1.5 m)			See sections on Brush Control and Evergreens or Conifer Control, pages 131 to 133, for susceptibility of woody species to 2,4-D and related compounds.

PERENNIAL WEED CONTROL (NON-CROPLAND) (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Canada thistle or perennial sow- thistle	dicamba/2,4-D (1 to 2) DYCLEER 24 (600 g/L)	3.3 kg/ha 5.5 L/ha	
	amitrole AMIZOL (50WP) AMITROLE (90WP)	1.6 kg/ha 3.2 kg/ha 1.5 kg/ha	Apply in 200 to 400 L water per hectare when thistles are in the head stage of growth, or apply to regrowth escaping other treatments.
	amitrole-t AMITROL-T (240 g/L) CYTROL (240 g/L)	1.6 kg/ha 7 L/ha 7 L/ha	Apply in 200 to 400 L water per hectare when thistles are in the head stage of growth.
Leafy and cypress spurge, field bindweed	TBA TBA-4 GENERAL WEED KILLER (400 g/L)	11 to 22 kg/ha 27 to 55 L/ha	Don't apply near valuable trees or shrubs. Active soil residues may last more than one year.
Field bindweed, milkweed, Canada thistle and common tansy	glyphosate ROUNDUP (356 g/L)	2.5 to 4.25 kg/ha 7 to 12 L/ha	Apply in 200 to 300 L water per hectare when field bindweed has reached full flower, and Canada thistle and milkweed have reached the bud to bloom stage.
Field bindweed	dicamba/2,4-D (1 to 2) DYCLEER 24 (600 g/L)	3.3 kg/ha 5.5 L/ha	Apply in mid-June or when flowering, in 100 to 200 L water per hectare.
Milkweed	amitrole AMIZOL (50WP) AMITROL (90WP)	4.5 kg/ha 9 kg/ha 5 L/ha	Apply in 500 to 1000 L water per hectare before flowering.
	amitrole-t AMITROL-T (240 g/L) CYTROL (240 g/L)	4.5 kg/ha 19 L/ha 19 L/ha	Apply in 1000 L water per hectare.
Goldenrod	2,4-D mixtures*	1 to 2 kg/ha	Apply in 1000 L water per hectare.
	dicamba/2,4-D DYCLEER 24 (600 g/L)	3.3 L/ha 5.5 L/ha	Apply when weed is actively growing, in 100 to 200 L water/ha.
Quack grass and other creeping perennial grasses	amitrole AMIZOL (50W) AMITROL (90W)	4.5 to 6.75 kg/ha 9 to 13.5 kg/ha 5 to 7.5 L/ha	Apply to actively growing quack grass foliage. Wait at least 10 days before plowing or disking. With amitrole or amitrole-t, most field crops can be planted safely 2 to 3 weeks after applying the chemical.

	amitrole-t AMITROL-T (240 g/L) CYTROL (240 g/L)	4 kg/ha 17 L/ha 17 L/ha	
	glyphosate ROUNDUP (356 g/L)	1.7 to 2.5 kg/ha 4.8 to 7 L/ha	Apply in 200 to 300 L water per hectare when quack grass is actively growing and has 3 to 4 new leaves on each shoot. Wait at least 5 days before mowing or working the area.
	dalapon DOWPON M (74WP) or BASFAPON (74WP)	8.5 to 12.5 kg/ha 11 to 16 kg/ha or 11 to 16 kg/ha	Apply to actively growing quack grass foliage. Wait at least 5 days before mowing or working the area. Dalapon will remain toxic to most crops for 4 to 5 weeks after application — possibly longer during cold or dry weather.
	propyzamide KERB	1.1 to 1.8 kg/ha 2.2 to 3.6 kg/ha	Apply in fall from late September to early November but before soil freezes. Control of weeds other than perennial grasses cannot be expected.
	atrazine*	See recommendations under field corn.	
Perennial weeds in pastures	See PASTURES.		

**Numerous commercial Formulations are available.*

WARNING: Unless otherwise recommended, the above treatments should not be used in crop situations. Their use should also be avoided if the chemical is likely to wash or leach into areas occupied by the roots of desirable trees or other plants.

Precautions should also be followed to avoid spray drift onto non-target vegetation.

The use of atrazine, simazine, bromacil, or diuron nonselectively as described above, is generally limited by cost to the handling of small patches of perennial weeds. The chemical either leaches down to the weed root system, or makes the surface soil toxic for a period of time, varying from a few months to several years depending on the chemical, rate of application, and soil type. Generally, crops cannot be grown successfully until the effect of the chemical has disappeared. Corn, however, can be grown safely when high rates of simazine and atrazine are applied.

Some perennial weeds such as field bindweed, horsetail, goldenrod, milkweed and bracken fern are difficult to eradicate at the lower rates of diuron, simazine, atrazine, and bromacil.

Follow the manufacturer's directions carefully if the area is to be reseeded. Both the dalapon and amitrole treatments are of value in spot-treating patches of quack grass in a field that is not entirely infested.

While the tops of many perennial weeds may be controlled by doses of 2,4-D that may be selectively used in resistant crops, heavier doses, as described above, must be used if eradication is to be attempted. Several applications upon successive stages of regrowth will probably be necessary. Generally, treatments with 2,4-D during rapid development of the weed, at about the early bud to flowering stages of growth, are most effective. Spray should be applied to thoroughly wet all foliage.

Heavier doses of 2,4-D on patches of weeds may be applied during normal selective spraying operations merely by slowing down the sprayer speed in the infested areas. Local crop damage should be expected where this is done.

The more persistent weeds such as leafy spurge and field bindweed are difficult to eradicate with 2,4-D, and a long-range control program using this chemical is usually followed. TBA gives good control of such deep-rooted perennials. Its action is similar to 2,4-D but it persists much longer in the soil.

2,4-D is ineffective against quack grass and other grassy perennials.

POISON-IVY CONTROL

Several chemicals have been shown to be effective for the control of poison-ivy. However, some growth may occur after treatment with any of these chemicals and re-treatments will be necessary to achieve eradication. The chemical treatment for poison-ivy must take into account the location in which the weed is growing. If desirable shrubs or trees are present, the soil sterilants should be avoided, and the other materials used with caution.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Poison-ivy	amitrole AMIZOL (50 SP) or AMITROL (90 SP)	3.24 kg/ha 6.5 kg/ha 3.6 kg/ha	Apply in at least 1000 L water per hectare when plant is actively growing. Thoroughly wet all foliage.
	amitrole-t AMITROL-T (240 g/L) or CYTROL (240 g/L)	4 kg/ha 17 L/ha 17 L/ha	Apply in at least 1000 L water per hectare when plants are actively growing. Thoroughly wet all foliage.
	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	200 to 250 g in 5 L water 400 to 500 g in 5 L water	Thoroughly wet all foliage.
	2,4-D/dichlorprop* (1:1)	2.25 kg/ha	Apply in sufficient volume of water to thoroughly wet all foliage.
	borate compounds	2 to 3 kg/10 m^2	Follow manufacturer's directions on the label.
	2,4-D/mecoprop/ dicamba**	1.1/0.55/0.1 kg/ha	Apply in at least 100 L water per hectare.
	dicamba/2,4-D (1 to 2) DYCLEER 24 (600 g/L)	0.85 + 1.7 kg/ha 4.25 L/ha	Apply in at least 560 L water per hectare.
	glyphosate ROUNDUP (356 g/L)	2.50 to 4.25 kg/ha 7 to 12 L/ha or 50 mL per 5 L water	Apply to actively growing plants in 200 to 300 L water per hectare to thoroughly wet the foliage, but do not spray to the point of run-off.

A 9 to 14 L sprayer is the most convenient method of applying herbicides to patches of poison-ivy. Thorough coverage of the leaves with the spray is essential for maximum effect. After spraying, the area should be left alone until the plants die, then the dead stems should be gathered up and buried. Even at this stage care should be taken as poisoning may be brought about by handling the dead plant.

All treatments are most effective when the poison-ivy is in full leaf and growing actively, from about June 15 to July 31.

** Numerous commercial formulations are available, see Table 1.*

***Number of commercial formulations is too numerous for specific mention.*

BRUSH CONTROL

There are several techniques that may be used for the chemical control of deciduous woody species: stem foliage sprays, basal bark sprays, frilling or spot treatments. The choice of technique will depend on such factors as brush type, accessibility, availability of equipment, proximity to susceptible crops or ornamental vegetation, and the size of the control program.

Stem Foliage Treatments with Water as a Carrier

Stem foliage treatment of brush should be limited to smaller growth (less than 2 m in height). Treatments should be applied to thoroughly wet the stems and foliage to the point of run-off. This technique is most effective just after full leaf development in late spring or early summer.

The choice of chemicals for controlling stands of deciduous brush should be based on the susceptibilities of the predominant species (Table 6), or whether the brush to be controlled is near homes, recreational areas, etc.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Most deciduous woody species	2,4-D*	3 to 6 kg/1000 L	Apply as the AMINE or LOW-VOLATILE ESTER. One application may be sufficient for sensitive species. For intermediately sensitive species, repeated treatments are normally required.
	2,4-D/dichlorprop** (1:1) (700 g/L)	5 to 6 kg/1000 L 7.1 to 8.5 L/1000 L	Apply as the LOW-VOLATILE ESTERS, in areas dominated by species expected to be tolerant to 2,4-D alone.
White ash, sugar maple	dicamba/2,4-D (1:2) DYCLEER 24 (600 g/L)	6 kg/1000 L 10 L/1000 L	Apply to the point of run-off when the leaves are fully expanded.
Most deciduous woody species	dicamba + (2,4-D + dichlorprop) DYCLEER (400 g/L) + DIPHENOPROP (700 g/L)	2.5 + (2.5 + 2.5) kg/ha Tank mix	Follow instructions on DYCLEER label.
Oak, maple, alder, hickory and ash	fosamine ammonium KRENITE (480 g/L)	5 to 7 kg/1000 L 10 to 15 L/1000 L	Thorough coverage is essential. The addition of 0.25 to 0.5% surfactant (WK, TWEEN 20, or TRITON X-100) may be required for difficult species like poplar or in mixed stands with conifers.
Non-selective control, most woody and herbaceous species	glyphosate ROUNDUP (356 g/L)	3.5 to 5 kg/1000 L 10 to 14 L/1000 L	Can be applied during June, July or August.
	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	200 to 250 g/5L 400 to 500 g/5L	Thoroughly wet all foliage.

BRUSH CONTROL (Cont'd)

** The commercial formulations containing 2,4-D are too numerous for specific mention in this publication.*

***There are numerous commercial formulations containing 2,4-D and dichlorprop, see Table 1.*

Basal-Bark Treatments in Oil as a Carrier

The BASAL-BARK treatment is useful on a wide range of trees and brush with a trunk diameter up to about 15 cm. The chemical is applied so as to thoroughly cover the basal 30 cm of the trunk and any exposed roots. For oak, hickory, basswood, or ash, treatments are most effective from February to June. Most other species may be treated at any season of the year.

Light, simple equipment, coupled with the possibility of winter operations, when labor is cheaper and access to swampy areas possible, give this treatment an important role in a brush control program.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Most woody species, including conifers	2,4-D/dichlorprop* (1:1) DIPHENOPROP (700 g/L)	2 kg/100 L 2.85 L/100 L	Use the LOW-VOLATILE ESTER formulations in fuel oil.
Hawthorn	2,4-D**	3 kg/100 L	Use the LOW-VOLATILE ESTER formulations in fuel oil.

** See Table 1 for the numerous commercial formulations that are available.*

***Commercial formulations containing 2,4-D are too numerous to mention.*

Stump Treatment after Cutting

In many cases it is more desirable to remove existing brush by hand than to kill it by spraying and leave the dead material standing. The stump treatment is particularly useful in preventing the vigorous regrowth that is the characteristic response of many deciduous species after the cutting. Moreover, killing the stump is the first step towards encouraging it to rot.

All of the treatments must be applied to freshly exposed wood. They may be applied at any season of the year, preferably right after the tree or brush is cut. If, however, an old stump is to be killed, it should be split with a wedge, or have holes drilled into it, so that fresh wood should be exposed to the chemical. Regrowth from an old stump should be treated as well as the stump proper.

Most species can be controlled with 2,4-D as the LOW-VOLATILE ESTER at a concentration of 2 kg (acid) per 100 L fuel oil. This treatment can be applied as a spray or paint.

If spray is used, all surfaces of the stump should be treated. Various dye (Dupont Rhodamine Red) materials may be added to the herbicide to facilitate keeping track of sprayed stumps.

EVERGREEN OR CONIFER CONTROL

Stem-Foliage Treatments with Water as a Carrier

All of the treatments are applied so as to **thoroughly** wet all foliage. Use low pressure and apply from 500 to 1500 L solution per hectare, depending on the amount of foliage. The TCA treatments of evergreens, applied during the growing season, will control balsam, spruce, and pine. Thorough coverage is particularly important, and the addition of a wetting agent will increase effectiveness. TBA (TRICHLOROBENZOIC ACID) is also effective on evergreens. It may be applied alone, or with ammonium sulfamate.

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Spruce, balsam, pine	TCA SODIUM-TCA (79G) NaTA (85P)	10 to 14 kg/1000 L 13 to 17 kg/1000 L 12 to 16 kg/1000 L	Follow manufacturer's directions on the label.
	TBA	3 kg/1000 L	Follow manufacturer's directions on the label.
	ammonium sulfamate WILSON'S POISON-IVY AND BRUSH KILLER (500 g/L)	3 kg/100 L 6 kg/100 L	Follow manufacturer's directions on the label.
	paraquat GRAMOXONE (200 g/L)	1 kg/1000 L 5 L/1000 L	Apply in spring or early summer. Thorough coverage is needed.
Mixed stands (conifers and deciduous brush).			The above treatments can be combined with 2,4-D, dichlorprop treatments that are recommended for the species of deciduous brush present (Table 6).
	dicamba/2,4-D (1:2) DYCLEER 24 (600 g/L)	2 + 4 kg/1000 L 10 L/1000 L	Apply as AMINES in early summer.
	dicamba plus 2,4-D/dichlorprop DYCLEER (400 g/L) plus DIPHENOPROP (700 g/L)	2.5 + (2.5 + 2.5) kg/1000 L 6.25 L + 7.2 L/1000 L	Apply in spring or early summer as AMINE. Thorough coverage is needed.

GENERAL TREATMENTS FOR WOODY SPECIES

Soil Treatment

Single or scattered trees or shrubs may be controlled efficiently with dry applications of sodium borate, chlorate mixtures, or ammonium sulfamate (WILSON'S POISON-IVY and BRUSH-KILLER). Apply the chemical in a band at the base of the plant, following the manufacturer's directions.

Basal (Spot) Treatment

On stands of brush that range from light to scattered, use individual spot treatment with bromacil (HYVAR X-L). It may be applied with an exact delivery hand-gun. Apply undiluted at 10 g per metre of height (5 cm diameter) brush or dilute 1 L HYVAR X-L with 5 L of water and apply 60 g per metre of height of brush. Taller and larger brush requires progressively more herbicide.

Sucker Control After Pruning

Many trees sprout prolifically after they have been pruned. The application of fortified tree-wound dressings to the surface of the cuts can reduce the number of new sprouts from many tree species. These paints improve natural inhibition achieved through the use of poor trimming practice. All pruning should be done to strong laterals. Severe pruning should be avoided.

Best results will be obtained if the materials are applied to the cuts between April 15 and July 15. Treatment of all cuts is important, as each is a potential location for sprouting from both dormant and adventitious buds. Cover the entire cut and about 2 cm of the surrounding bark especially below the cut. Heavy tree-wound dressing will adversely affect rate of callus formation of some species.

Alpha naphthalene acetic acid, ethyl ester (TRE-HOLD) as a 1% surface tree-wound dressing or aerosol can be effective on willow, poplar, maple, oak, elm, basswood, apple and possibly other species.

TABLE 6. SUSCEPTIBILITY OF WOODY PLANTS TO FOLIAGE SPRAYS OF 2,4-D, 2,4-D MIXTURES and AMMONIUM SULFAMATE

Common Name	2,4-D	2,4-D Dichlorprop (1:1)	2,4-D Dicamba (2:1)	Ammonium sulfamate
alder	S-I	S	S	
arborvitae	R	R		S-I
ash	R	S-I		
barberry, common	I	S		
basswood	R	S	S	
beech	R			S-I
birch	S	S	S	S
blackberry	R			I-S
blueberry	S	S		I
buckthorn	I-R			I
cedar	R	I-R	S	S-I
cherry, black, red	S-I	S	S	S
cherry, choke	S-I	S	S	S
cranberry	S			
creeper, Virginia	S	S-I		R
currants, wild	R			I
dogwood	S-I	S		S-I
elderberry	S			S-I
elm	I	S-I	S	S-I
fir, balsam	R	S-I	S	S-I
grape, wild	S	S		
hardhack, spiraea	I			I
hawthorn	I-R	S	I-S	I
hemlock	R			S-I
hickory, black, shagbark	R	S-I	S	S-I
honeysuckle	S-I	S		S
ironwood	R	S-I		I
juniper	R	I-R		I-R
lilac	I-R			I
locust, black	I			I
locust, honey	S-I			I
maple, Manitoba	S-I	S		S-I
maple,				
red	R	I-R		S-I
silver	S-I			S
sugar	R	S-I	I-R	S-I
oak,				
red	I	I-R	S	S
white	I	S-I		S
bur	R-I			
pine	R	S-I	S	S
plum, wild	I	S		
poison-ivy	I	S-I	S	S
poplar, aspen	S	S	S	I
prickly ash	R			
raspberry, wild	R	S		I-S
redbud				
rhododendron	R			R
rose, wild	R	I	S	
sassafras	S-I			I-S
sheep-laurel	I			
spruce	R	I-R	S	
sumac, poison	S			
sweet fern	I			S-I
viburnum	R			I
walnut	S-I			S
willow	S	S	S	S

S *Susceptible. Adequate control obtained with one application.*
I *Intermediate. Retreatment is usually needed for adequate control.*
R *Resistant. Two or more applications may not be adequate.*

WATER WEEDS (AQUATIC PLANTS)

A permit is usually necessary for the application of herbicides or other pesticides to water or a watercourse. However, no permit is required by the owner to treat a pond which is entirely within his property and has no outflow; or for a person to treat a drainage ditch which is considered dry (contains water 50% or less of the year).

Purchase of certain compounds for treating enclosed ponds requires authorization (these include simazine, CUTRINE PLUS, ALGIMYCIN PLL-C, REGLONE A, AQUAKLEEN, and GRAMOXONE) from the Ministry of the Environment.

For further information on licensing and permits, contact any Ministry of the Environment Regional Office or Ministry of the Environment, Pesticides Control Section, 135 St. Clair Avenue West, Toronto, Ontario, M4V 1P5, Telephone: (416) 965-2401.

ALGAE AND VASCULAR SUBMERGENTS

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE PRODUCT	REMARKS
Filamentous algae, pond scums	copper compound	0.175 to 0.35 kg/1000 m^3 of water	Not for use in public waters or waters draining into public waters. Not for use in potable waters. To be applied to areas where algae is well established and growing vigorously. Do not apply in deep water.
	SLOW RELEASE ALGIMYCIN PLL-C (5% PE)	3.5 to 7 kg/1000 m^3 (1,000,000 L) of water	
	copper compound	0.15 L/1000 m^3 0.3 to 0.45 L/1000 m^3	Treat 1/3 of a pond at a time to avoid oxygen depletion. Wait 72 hours before treating the next section. Care must be taken where fish are present.
	LIQUID ALGIMYCIN PLL-C (5% SN)	3 L/1000 m^3 (1,000,000 L) of water, dilute about 1 to 4 with water 6 to 9 L/1000 m^3 of water, dilute about 1 to 2 with water (marginal or spot treatments)	
	copper sulphate BLUESTONE (25.2% GR)	0.13 to 0.25 ppm 0.5 to 1.0 ppm; do not exceed 0.5 to 0.7 ppm in hard water where trout are present	Water hardness is very important to take into consideration when using copper sulphate particularly if fish are present. It is extremely toxic to salmonids in soft water. For use only in ponds with no outflow beyond property limits.

	copper compound CUTRINE PLUS (9.0% Li)	0.83 L/ha; 2.5 L/ha If average water depth is 0.5 m use 9.21 L/ha; if 1.5 m use 27.63 L/ha. Dilute these at 1 to 9 before applying.	Used only in water where there is no flow from the property. Not for use in potable waters. No restrictions on swimming or fishing. Care should be taken if fish are present.
Filamentous algae, pond scums	simazine SIMMAPRIM 80 W (77.6% WP)	4.7 g/10,000 L of water 9.7 g/10,000 L of water 6 g/10,000 L of water (0.6 g/m^3 of water), where there is no flow-through 12.5 g/10,000 L of water (1.2 g/m^3 of water), where flow is minimal	Water from treated ponds is not to be used for irrigation or human consumption. Fish taken from treated ponds not to be used for human consumption. Treat early before dense growth starts. To avoid oxygen depletion later in season treat the pond in sections.
Submerged plant-like algae: Chara and Nitella spp, in ponds	copper compound SLOW RELEASE ALGIMYCIN PLL-C (5% PE)	1.1 kg to 2.3 kg/ha 22.5 kg to 45 kg/ha	Use the lower rate if treated when the vegetation is young and actively growing. Higher rates to be used later in the season as plants become more resistant.
	copper compound BLUESTONE (25.2% GR)	0.38 ppm 1.5 ppm (0.5 to 0.7 ppm if trout are present in hard to moderately hard water).	Careful calculations should be made if fish are present. Re-treatment may be necessary after several days.
	copper compound CUTRINE PLUS (9% Li)	1.7 L/ha; 5.0 L/ha If average water depth is 0.5 m use 18.42 L/ha; if 1.5 m use 55.26 L/ha — dilute these at 9 to 1 before applying.	In hard water CUTRINE PLUS is toxic to fish if 0.4 ppm is exceeded. If fish are present but water hardness is not known, do not use CUTRINE PLUS.
	simazine SIMMAPRIM 80 W (77.6% WP)	17.5 g/10,000 L to 27.9 g/10,000 L 22.5 g/10,000 L of water (2.4 g/m^3 of water) to 36 g/10,000 L of water (2.4 to 3.6 g/m^3 of water)	Use the higher rate when heavy infestations occur. Do not use treated water for irrigation or human consumption. Do not use fish taken from treated water for human consumption.
Emerged and submerged rooted aquatic plants	simazine SIMMAPRIM 80W (77.6% WP)	21.3 kg in 500-2000 L of water/ha OR 233 g in 10 to 30 L of water/ha 27.5 kg in 500-2000 L of water/hectare OR 300 g in 10 to 30 L of water/100 m^2	"Drawdown treatment" — application should be made to exposed soil or mud when water level is lowered. Apply in the fall before freeze-up or as early in the spring as possible. Do not raise water level until sufficient rainfall has occurred to carry the chemical into the soil.

ALGAE AND VASCULAR SUBMERGENTS (Cont'd)

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Emerged and submerged rooted aquatic weeds	simazine SIMMAPRIM 80W (77.6% WP)	8.3 g/10,000 L 12 g/10,000 L of water OR 1.2 g/m^3 of water	Water flow to be shut off and remain so for 10 days after treatment. Do not use treated water for irrigation or human consumption. Fish taken from treated ponds should not be used for human consumption.
Mixed submerged aquatics in ponds	diquat REGLONE A (200 g/L Sn)	4.4 kg/L/ha; 6 kg to 7 kg/L/ha 22 L/ha in 1.5 m or less: use 30 to 35 L/ha if greater than 1.5 m	Do not use treated water for consumption or swimming for 24-hours. Do not use for irrigation for 5 days. To avoid oxygen depletion treat only 1/4 to 1/3 of the area at a time. Apply at dusk in mid-to-late June when plants are young and growing vigorously. Tape grass and Chara are NOT controlled.
	2,4-D low-volatile ester AQUA KLEEN (20% GR)	22 to 45 kg/ha 110 to 225 kg/ha	Treat in spring or early summer when weeds are starting to grow. When weed mats are dense and water is over 2 meters use the higher rate. Read label carefully regarding restrictions on use of treated waters. Tape grass and Chara are NOT controlled.
Eurasian water milfoil in lakes	diquat REGLONE A (200 g/L)	2.2 kg/ha of water surface 11 L/ha of water surface	Treat when plants are in the very early stage of growth (June).
	2,4-D low-volatile ester AQUA KLEEN (20% GR)	22 to 45 kg/ha 110 to 225 kg/ha	Treat in spring and early summer when plants are starting to grow. Read label for restrictions on treated water use.

Emergents

WEEDS	Generic Name TRADE NAME & (Formulation)	Rate (Active) RATE (PRODUCT)	REMARKS
Arrowhead, water plantain, pickerel weed, wild rice, cattails, bulrushes in swamps and drainage ditches.	paraquat GRAMOXONE (200 g/L)	1.1 kg to 2.2 kg in 850 to 1000 L of water/ha 5.5 to 11 L in 850 to 1000 L of water/ha to be treated	Do not use treated water for 7 days for swimming, human or animal consumption. Do not use for irrigation for 5 days. Do not apply to muddy water or agitate water excessively for 1-2 days after treatment.
	amitrole AMINO TRIAZOLE (50% SP)	9 to 11 kg in 3000 to 4000 L of water/ha 18 to 22 kg in 3000 to 4000 L of water/ha^2	To control cattails in marshes and drainage ditches. Apply after catkins are fully formed but before frost. Do not apply where water will be used for irrigation, drinking or other domestic purposes.
Arrowhead, water plantain, pickerel weed, wild rice, cattails, bulrushes in swamps and drainage ditches.	dalapon DOWPON M (74% WP)	20.4 to 33.3 kg/ha in 450 L of water 7.4 to 14.8 kg/ha in 1000 L of water 27.5 to 45 kg/ha in 450 L of	Apply 7 days before a killing frost. Spray after sprouts have emerged and are 0.5 to 1.0 metres tall. For use only in drainage and irrigation ditches.

		water (spray boom) 10 to 20 kg in 1000 L of water (orchard-type spray gun).	
Water lilies	2,4-D low-volatile ester AQUAKLEEN (20% GR)	35 to 45 kg/ha 175 to 225 kg/ha of water surface	Repeat treatment for yellow water lily or spatterdock may be necessary. Treat in mid- summer.
Duckweed	diquat REGLONE A (200 g/L)	2.2 kg/ha of water surface 11 L/ha of water surface	Apply by directed surface spray on foliage. Use 1 part REGLONE A with at least 4 parts of clean water.

The use of herbicides may be complicated by the use of water by livestock or humans or by the presence of fish. If the water is flowing, the effect of the chemical on plant, animal, or fish life down stream must be considered. Flowing water, by diluting the herbicide, makes control less effective. The vegetation also varies widely: including completely submerged ones such as *Elodea* (Canada waterweed) and algae, free-floating ones such as duckweed, anchored-floating ones such as water-lilies, and emergent plants. Many of these will grow equally well on the moist shoreline as when their lower stems and roots are in water. Where these emergent species have taken possession of the shoreline, control measures must embrace that area as well as the water.

Copper sulfate is the standard treatment for algae control in ponds. At the concentration given, it is non-poisonous to most fish and livestock. The copper sulfate may be dissolved in water and applied to the pond surface as a spray, or it may be placed in a burlap bag and dragged through the water until it has dissolved. Long-term or permanent control of algae in ponds is not possible because of its ability to rapidly reinfest an area.

Simazine can provide a season's control of algae in ponds having a minimum flow-through. Simazine should not be applied to ponds used for irrigation.

Chara (Stonewort, muskgrass) is a gray-green to green plant-like algae, attached to the sediment, which in dense communities has a very strong musk odor. It is brittle to the touch and will dry to a white powder upon removal from the water. This plant is difficult to control with moderate doses of algicides and dense communities should be removed mechanically.

Tape-grass (wild celery) (*Vallisneria americana*) found in many recreational lakes, is resistant to all the currently recommended herbicides. It has long rubber-like leaves and numerous short roots. Control must be confined to mechanical methods such as pulling.

Diquat provides good control of a wide variety of submergent species including water-milfoil, pondweeds, *Elodea* (Canada waterweed) and coontail. This herbicide is not effective against muskgrass (*Chara* spp). Diquat should be applied on cloudy days in late afternoon and care should be taken not to stir up the bottom since turbidity reduces the effectiveness of treatment. Since diquat takes effect rapidly, decomposition of a large plant mass may cause oxygen depletion problems which can cause fish to suffocate. Thus, in ponds where fish are present and growth is well established, half of the pond should be treated at one time and the other about two weeks later. The best time to apply these chemicals is late spring while the plants are growing rapidly. Since this is a contact chemical, control is achieved for one season, and repeat treatments must be made annually.

2,4-D ester (AQUA KLEEN) consists of specially formed and hardened 2,4-D granules which sink rapidly to the bottom of lakes or ponds where release of chemical takes place. Muskgrass and tape-grass are not controlled. Since this herbicide is systemic in action, collapse of the plant community may take 2 or 3 weeks. Treat in spring when growth is young (60 to 90 cm long). Apply as described above when large areas are treated. Control achieved is for one season.

For control of waterlilies apply AQUA KLEEN in mid-July to early August, after plants have flowered. At least two successive treatments (one per year) will be required.

Emergent species such as cattails and bulrushes may have to be sprayed for 2 or 3 consecutive years to bring them under complete control. The chemicals for cattails and other emergents are sprayed so as to thoroughly wet all exposed foliage. Paraquat and amitrole are most effective when cattails are coming into head. Dalapon should be applied using an orchard-type gun. Consult manufacturer's directions.

Additional information may be obtained by contacting the Ministry of the Environment, Pesticides Control Section, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5, Telephone: (416) 965-2401.

METRIC EQUIVALENTS
1 kilogram per hectare (kg/ha) = 0.89 pounds per acre
1 litre per hectare (L/ha) = 0.7 pints per acre
SEE PAGE 150 FOR OTHER METRIC EQUIVALENTS

TABLE 7. HABITATS AND HERBICIDES SUSCEPTIBILITY OF COMMON AQUATIC PLANTS

	A	B	C	D	E	F		1	2	3	4	5	6	7
	Spring-Fed Pond	Dugout	Soft Water Lake	Hard Water Lake	Wet Ditch***	Dry Ditch****								
ALGAE														
Spirogyra sp.	VC	VC	C1		VC	1		S	S	S	R	R		
Ulothrix sp.	C	VC			VC			S	S	S	R	R		
Mougeotia sp.	C	VC			VC			S	S	S	R	R		
Cladophora sp.	VC	VC	C	VC	VC			1	S	S	R	R		
Chara sp. (Chara stonewort,	VC	1	C1	VC1	VC	R		1	S	S1	R	R		
Muskgrass)	1	R	C	R	R	R		1	S	S1	R	R		
Nitella sp. (Stonewort)	1	R	C	R	R	R		1	S	S1	R	R		
SUBMERGENT MACROPHYTES														
Sago pondweed (*Potamogeton pectinatus*)	1	C1		VC				R	R	S	S	S		
Curly-leaf pondweed (*P. crispus*)	C	VC		VC				R	R	S	S	S		
Bass weed (*P. amplifolius*)	R	C		C				R	R	S1	1			
Richardson pondweed (*P. richardsonii*)				VCO				R	R	S1	S1	S		
Flat stemmed pondweed (*P. zosteriformis*)				C				R	R		S			
Other narrow-leaf pondweeds (*Potamogeton* sp.)	1	C	C	VCO				R	R	S	S	S		
Eurasian water milfoil (*Myriophyllum spicatum*)			VC					R	R	S	VS	VS		
Native milfoil (*M. exalbescens* & others)	C		C	VC				R	R	S	VS	VS		
Bladderwort (*Utricularia vulgaris*)		C		C				R	R	S	S1			
Coontail (*Ceratophyllum demersum*)		C		VC				R	R	S1	1	1		
Water Stargrass (*Heterantheria dubia*)				C				R	R		S1			
Tape Grass (*Vallisneria americana*)	R	1	C	VC	R	R	**MM	R	R	R	R	R	R	
Water naiad (*Najas flexilis*)		1		VC				R	R	S	S			
Canada water weed (*Elodea canadensis*)		C		VC					R	R	S1	1	S1	
EMERGENTS														
Cattails (*Typha latifolia, T. angustifolia*)	VC	VC		VC	VC	1C	M	R	R	R	R	R	1	S1
Bulrush (*Scirpus* spp.)			C	VC	C	C	M	R	R					S1
Sedge (*Carex* sp.)			C	C	C	VC	M	R	R					S1
# Bur reed (*Sparganium* spp.)	C		C	C	C	VC	M	R	R					1
Water plantain (*Alisma* spp.)			1	C	C	VC		R	R					S
Pipewort (*Eriocaulon* spp.)	R	R	C	R	R	R	*M	R	R				S	
Arrowhead (*Sagittaria* spp.)		C		VC	1C			R	R				S	
Pickerelweed (*Pontederia* spp.)			VC		1	R		R	R				S1	
Water smart weed (*Polygonum amphibium*)	1	1						R	R				S1	
Water shield (*Brasenia* spp.)			C					R	R				S1	
White water lily (*Nymphaea* spp.)			C	C			*M	R	R			1	1	
Yellow water lily (*Nuphar* spp.)		C1	C	C			*M	R	R			1	1	
Duckweed (*Lemna* spp.)	R	C	1R	VC				R	R		S		S	
Duckmeal (*Wolffia* spp.)	R	C1	1R	VC				R	R		S		S	

VC — Very Common
C — Common
I — Infrequent
R — Rare
# — Bur reed is also very common as a submerged plant in ecotypes C and D.
** A typical Muskoka lake is an example of a soft water lake.*
*** A typical Kawartha lake is an example of a hard water lake.*
**** A wet ditch generally contains water 80 to 90% of the year.*
***** A dry ditch generally contains water 50% or less of the year.*
S — Susceptible
I — Intermediate

R — Resistant
M — Manual/mechanical methods equally as effective as herbicides.
**M — Manual/mechanical methods generally more effective than herbicides.*
***MM — Manual/mechanical methods are the only control measures currently available.*
1 — Copper Sulfate
2 — CUTRINE PLUS: ALGIMYCIN PLL-C
3 — Simazine (in enclosed pond systems only)
4 — Diquat
5 — 2,4-D granular
6 — Paraquat
7 — Amitrole, dalapon, glyphosate (in dry ditches only)

TABLE 8. CLASSIFICATION OF WEEDS ACCORDING TO RESPONSE TO VARIOUS FOLIAGE SPRAYS

	2,4-D	MCPA	2,4-DB or MCPB	Mecoprop	Dicamba
aster (P)	I				
bedstraw (P)	R	R	R	S-I	
bellflower (P)	R				
bindweed, field (P)	I	I	I	I	I
blueweed (B)	S-I			I	I
bracken fern (P)	R	R	R	R	I
buckwheat, wild (A)	I	I	I-R	I	S
burdock (B)	S	S	I		S
buttercup (P)	I	S-I	I**(I-R)	I	
campion, bladder (P)	R	R	R		
carrot, wild (B)	S-R	S-R	R	I-R	
catchfly, night-flowering (A)	R	R	R	R	
catnip (P)	S-I				
chickweed, common (A)	I	I	R	S	S
chickweed, mouse-eared (P)	I-R	I-R	R	S	S
chicory (P)	S	S-I	S-I*(R)	I-R	
cinquefoil, rough (WA)	I				
cinquefoil, sulfur (upright c.), (P)	I				
cocklebur (A)	S	S	S	S	S
cockle, purple (A)	I-R	R	R		I
cockle, white (P)	R		I-R		I
daisy, ox-eye (P)	I	I	R		
dandelion (P)	S	S	I*(R)	I	
dock (P)	I	I	I	I	
evening-primrose (B)	S				
false flax (WA)	S	S	S	S	
fleabane, annual (daisy f.) (WA)	I	I	S-I		
fleabane, Canada (A)	S-I				
goat's-beard (B)	I				
goldenrod (P)	I	R	I		
goosefoot (A)	S	S	S	S	
goutweed (P)	R	R	R	R	
grasses (A and P)	R	R	R	R	
ground-ivy (creeping charlie) (P)	I-R	I-R		I	S
groundsel (A)	I	I			
hawkweed (P)	I-R	I-R			
heal-all (P)	I-R	I-R	I-R	S	
hemp-nettle (A)	R	S-I	I-R**(R)	R	
horse-nettle (P)	R				I
horsetail (P)	I-R		I-R	I-R	I
knapweeds (P)	R				I
knotweed (A)	I		I*(I-R)	S-I	S
Lady's-thumb (A)	I	R	I-R*(R)	I	S
lamb's-quarters (A)	S	S	S	S	S
lettuce, prickly (A)	S	S	S	S	
mallow, round-leaved (P)	I-R	I-R	I-R	I-R	
mayweed (A)	I-R		R		S
medick, black (WA)	I	I	I	S	I
milkweed (P)	R	R	R	I-R	
motherwort (P)	S-I				
mullein (B)	I-R				
mustards (A)	S	S	I	S	
nightshade (P)	I-R			R	
parsnip, wild (B)	S				

TABLE 8. CLASSIFICATION OF WEEDS (cont'd)

	2,4-D	MCPA	2,4-DB or MCPB	Mecoprop	Dicamba
pepper-grass, common (WA)	S	S	I		
pepper-grass, field (WA)	S	S	I		
pigweeds (A)	S	I	S-I	S	S
pineappleweed (A)	S		R	R	
plantains (P)	S	S	S-I	S-I	I
purslane (A)	I	I	S-I	S-I	
ragweed (A)	S	S	S	S	
ragwort	R				I
ribgrass (P) (see plantains)					
rocket, yellow (B)	S	I	I*(R)		
shepherd's-purse (WA)	S	S	I		
smartweed, green (A)	I	I	I	R	S
sorrel, sheep (P)	I	R			
sow-thistle, annual (A)	S	I	S	I	
sow-thistle, perennial (P)	I	R	S-I*(I-R)		S-I
speedwells (A or P)	I-R	I-R		S-I	
spurge, cypress (P)	I-R	I-R	I-R		I
spurge, leafy (P)	I-R	I-R	I-R	R	I
spurry, corn (A)	R	I	R	I	S
St. John's-wort (P)	R	R	R	R	
stinkweed (pennycress) (WA)	S	S	S-I	S	S
stonecrop, mossy (P)	I	I		S-I	
teasel (B)	I				
thistle, bull (B)	S	S	S	S	
thistle, Canada (P)	I	I	I	I	S-I
thistle, nodding (B)	I		I		
thistle, Russian (A)	S-I		I-R	R	S-I
toadflax (P)	R	R	R	R	
velvetleaf (A)	S-I	I	S-I*(I-R)		
vetch (P)	I-R	I-R	R	I-R	I
vetches, wild (A)	S	S			
violet, field (field pansy) (A)	R			R	
water-hemlock (P)	S-I				
wood-sorrel (P)	I-R				
yarrow (P)	R			I	

** 2,4-DB more effective (susceptibility to MCPB given in brackets)*
***MCPB more effective (susceptibility to 2,4-DB given in brackets)*

KEY:	**Plant Classification**		**Response to Foliage Sprays**
(A)	annual	S	**susceptible** i.e. killed by 1 application of 2,4-D, MCPA, or Mecoprop (1.12 kg or less per hectare); or by 1 application of Dicamba (425 g or less per hectare).
(WA)	winter annual		
(B)	biennial	I	**intermediate** i.e. killed less rapidly but controlled, either by higher rates or by repeated applications.
(P)	perennial	R	**resistant** i.e. not or only slightly damaged by chemical treatment. Control of this weed is not practical with herbicide(s) listed above this column.
		S-I	between susceptible and intermediate.
		I-R	between intermediate and resistant.

ONTARIO MINISTRY OF THE ENVIRONMENT — PESTICIDES CONTROL FIELD OFFICES

County	District	Telephone
Essex, Kent, Lambton	H.E. Collins P.O. Box 237, 435 Grand Ave. W. Chatham N7M 5K3	519-352-5107
Southwestern Region		
Elgin, Middlesex, Oxford	D.C. Morrow & W. Lampman 985 Adelaide Street South, London N6E 1V3	519-681-3600
Haldimand, Norfolk, Niagara, Hamilton, Wentworth	J. Percy Ont. Gov't. Bldg., 119 King St. W. Hamilton L8N 3Z9	416-521-7640
West Central Region		
Dufferin, Wellington, Waterloo, Brant	R. Miller P.O. Box 219, 400 Clyde Road, Cambridge (Galt) N1R 5T8	519-623-2080
Bruce, Grey, Huron, Perth	B.T. Lobb 20 King Street, Ont. Ministry of Agr. & Food Bldg. Clinton N0M 1L0	519-482-3248
Southwestern Region		
Simcoe, Muskoka	W. Cowie 12 Fairview Road, Barrie L4N 4P3	705-726-1730
Central Region		
Halton, Peel, York, Durham, Toronto	T. O'Neill & D. Trenholm 150 Ferrand Drive, Suite 700, Don Mills M3C 3C3	416-424-3000 (ext. 204)
Peterborough, Victoria, Haliburton, Northumberland	A.G. Carpenter 139 George Street N., Peterborough K9J 3G6	705-743-2972
Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville	D.A. Raddon 133 Dalton St., Box 890, Kingston K7Z 4X6	613-549-4000
Southeastern Region		
Prescott & Russell, Renfrew, Stormont, Dundas & Glengarry, Ottawa-Carleton, Lanark	R.P. Cameron 2378 Holly Lane, Suite 204, Ottawa K1V 7P1	613-521-3450
Manitoulin, Nipissing, Parry Sound, Sudbury	D.J. Mewett Northgate Shopping Centre, 1500 Fisher St., North Bay P1B 2H3	705-476-1001

Northeastern Region		
Cochrane, Timiskaming, Algoma	P. McCubbin 83 Algonquin Blvd. W., Timmins P4N 2R4 Sault Ste. Marie	705-264-9474 705-949-4640
Kenora, Rainy River, Thunder Bay	G.R. Gammond Ontario Government Building, 435 James St. S. Thunder Bay "F" P7E 6E3	807-475-1305
Head Office	Pesticides Control Section 135 St. Clair Avenue W., Suite 100 Toronto, Ontario M4V 1M2	416-965-2401

ONTARIO MINISTRY OF AGRICULTURE AND FOOD
County and District Offices

Algoma	1496 Wellington St. E., Sault Ste. Marie P6A 2R1	705-253-1161	Muskoka & P.S.	Box 130, Huntsville, P0A 1K0	705-789-5491
Brant	207 Greenwich St., Brantford N3S 2X7	519-759-4190	Niagara N.	Vineland Station L0R 2E0	416-562-4142
Bruce	Box 1330, Walkerton N0G 2V0	519-881-3301	Niagara S.	574 South Pelham St., Welland L3C 3C6	416-732-7552
Carleton	26 Thorncliffe Place, Nepean K2H 6L2	613-828-9167	Nipissing	222 McIntyre St. W., North Bay P1B 2Y8	705-474-3050
Cochrane N.	Experimental Farm, Kapuskasing P5N 2X9	705-335-5828	Norfolk	Box 587, Simcoe N3Y 4N5	519-426-7120
Cochrane S.	Box 608, Matheson P0K 1N0	705-273-2509	Northumberland	Box 820, Brighton K0K 1H0	613-475-1630
Dufferin	R.R. 4, Orangeville L9W 2Z1	519-941-3830	Ontario	Box 309, Uxbridge L0C 1K0	416-852-3328
Dundas	Box 488, Winchester K0C 2K0	613-774-2313	Oxford	Box 666, Woodstock N4S 7Z5	519-537-6621
Durham	234 King St. E., Bowmanville L1C 1P5	416-623-3348	Peel	3 Elizabeth St. S., Brampton L6Y 1P7	416-451-5474
Elgin	594 Talbot St., St. Thomas N5P 1C7	519-631-4700	Perth	413 Hibernia St., Stratford N5A 5W2	519-271-0280
Essex	46 Fox St., Essex N8M 2S2	519-776-7361	Peterborough	55 George St. N., Peterborough K9J 3G2	705-745-2403
Frontenac	Box 651, Kingston K7L 1H3	613-544-1995	Prescott	Box 110, Plantagenet K0B 1L0	613-673-5115
Glengarry	Box 579, Alexandria K0C 1A0	613-525-1046	Prince Edward	Box 470, Picton K0K 2T0	613-476-3224
Grenville	Box 2004, Kemptville K0G 1J0	613-258-3416	Rainy River	Front St., Emo P0W 1E0	807-482-2310
Grey	181 Toronto St. S., Markdale N0C 1H0	519-986-2040	Renfrew	315 Raglan St. S., Renfrew K7V 1R6	613-432-4841
Haldimand	Box 129, Cayuga N0A 1E0	416-772-3381	Russell	Box 540, Embrun K0A 1W0	613-443-3391
Halton	17 Wilson Dr., Milton L9T 3J7	416-878-2314	Simcoe N.	Box 340, Elmvale L0L 1P0	705-322-2231
Hastings	Box 340, Stirling K0K 3E0	613-395-3393	Simcoe S.	Box 370, Alliston L0M 1A0	705-435-5521
Huron	Box 159, Clinton N0M 1L0	519-482-3428	Stormont	Box 655,109-11th St.W. Cornwall K6H 5T3	613-933-1581
Kenora	Ont. Gov't Bldg., Box 3000, Dryden P8N 3B3	807-223-2415	Sudbury	1414 La Salle Blvd., Sudbury P3A 1Z0	705-566-1630
Kent	P.O. Box 726, 435 Grand Ave. W. Chatham N7M 5L1	519-354-2150	Timiskaming	Box "G," New Liskeard, P0J 1P0	705-647-6701
Lambton	Box 730, Petrolia N0N 1R0	519-882-0180	Thunder Bay	Ontario Government Bldg., 435 James St. S. Thunder Bay F, P7E 6E3	807-475-1631
Lanark	10 Sunset Blvd., Perth K7H 2Y2	613-267-1063	Victoria	322 Kent St. W., Lindsay K9V 2Z9	705-324-6125
Leeds	Box 635, Brockville K6V 5V8	613-342-2124	Waterloo	279 Weber St. N., Waterloo N2J 3H8	519-884-5390
Lennox & Add.	41 Dundas St. W., Napanee K7R 1Z5	613-354-3371	Wellington	Box 159, Fergus N1M 2W7	519-846-5371
Manitoulin	Box 328, Gore Bay P0P 1H0	705-282-2043	Wentworth	R.R. 1, Ancaster L9G 3K9	416-527-2995
Middlesex	367 Ridout St. N., London N6A 2P2	519-434-6811	York	Newmarket Plaza, Newmarket L3Y 2N1	416-895-4519

Plant Industry Branch
Crop Advisory Service

Field Crop Specialists

Essex, Kent, Lambton	J. C. Schleihauf, RCAT Ridgetown N0P 2C0	519-674-5456
Elgin, Middlesex, Norfolk	D. T. Morris, 594 Talbot St. St. Thomas N5P 1C7	519-631-4700
Huron, Perth	P. Lynch, 413 Hibernia St. Stratford N5A 6T3	519-271-0280
Wellington, Waterloo	H. D. Martin, Land Resource Science Dept., U. of Guelph N1G 2W1	519-824-4120 (ext. 2454)
N. & S. Niagara, Haldimand	K. Bereza, R.R. 1 Ancaster L9G 3K9	416-527-2995
Brant, Oxford, Wentworth	H.C. Wright, Crop Science Dept., U. of Guelph N1G 2W1	519-824-4120 (ext. 2513)
Bruce, Grey, Dufferin	R. A. Upfold, Box 1330 Walkerton N0G 2V0	519-881-3301
N. & S. Simcoe	Box 370 Alliston L0M 1A0	705-435-5521
Halton, Peel, York	H. Olechowski, Newmarket Plaza, Newmarket L3Y 2N1	416-895-4519
Durham, Victoria, Ontario Peterborough	N. E. Moore, 322 Kent St. W. Lindsay K9V 2Z9	705-324-6125
Northumbland, Hastings, Frontenac, Lennox & Addington, Prince Edward	Howard Lang, Box 470 Picton K0K 2T0	613-476-3224
Leeds, Grenville, Dundas, Stormont	B. Archibald, Ont. Gov't. Bldg., Box 2004, Kemptville K0G 1J0	613-258-3411
Renfrew, Lanark, Carleton	G. Winnicki, Ont. Gov't. Bldg. Box 2004, Kemptville K0G 1J0	613-258-3411
Prescott, Russell, Glengarry	P. E. Beaudin, Box 110 Plantagenet K0B 1L0	613-673-5115
Northern Ontario	W. R. Riley, 222 McIntyre St. W., North Bay P1B 2Y8	705-474-3050
Seeds and Weeds	R. D. McLaren, Crop Science Dept. U. of Guelph, N1G 2W1	519-824-4120 ext. 2513
Insects — Field Crops	K. Bereza, R.R. 1 Ancaster L9G 3K9	416-527-2995

Horticultural Crop Specialists

Eastern Ontario	Stephen Rowe, KCAT Kemptville, K0G 1J0	613-258-3411
Prince Edward, Hastings	W. Ingratta, P.O. Box 470 Picton K0K 2T0	613-476-3224
Northumberland, Peterborough	David Ridgway, P.O. Box 340 Trenton K8V 5R5	613-392-3527
Durham, Ontario, Victoria	I.B. Ells, 234 King St. E. Bowmanville L1C 1P5	416-623-3348
N. York (Bradford Marsh)	*M. Valk, Research Station R.R. 1, Kettleby, L0G 1J0	416-775-3783
Simcoe, Dufferin, Grey	K. Wilson, P.O. Box 69 Clarksburg N0H 1J0	519-599-2042
Halton, N. Wentworth, Peel	J. Uyenaka, 17 Wilson Dr. Milton L9T 3J7	416-878-2314
N. & S. Niagara, Haldimand, S. Wentworth	R. Wilcox, I. Smith, W. Brown, Vineland Station L0R 2E0	416-562-4142
Norfolk, Brant	J.R. Chard, Hort. Research Sta. Box 587, Simcoe N3Y 4N5	519-426-7120
Oxford, Elgin	K. Priest, P.O. Box 666 Woodstock N4S 7Z5	519-537-6621
Lambton, Middlesex, Huron	J. Gardner, 195 Dufferin Ave. London N6A 1K7	519-434-6811
Essex	J. C. Fisher, L. Huffman, Research Station, Harrow N0R 1G0	519-738-2251
Kent	E. Tomecek, RCAT Ridgetown N0P 2C0	519-674-5456
Potatoes	S. Squire, Box 370 Alliston, L0M 1A0	705-435-5521
Tobacco	M.C. Watson, N.W. Sheidow, Research Station, Box 186 Delhi N4B 2W9	519-582-1950
Floriculture and Mushrooms	W. Brown, Vineland Station L0R 2E0	416-562-4142
Floriculture	J. Hughes, 3 Elizabeth St. S. Brampton L6Y 1P7	416-451-5474
Diseases	C. Hunter, Research Station P.O. Box 587, Simcoe N3Y 4N5	519-426-7120

Plant Industry Branch
Crop Advisory Service — continued

Horticultural Crop Specialists

Insects — Hort. Crops	W. Roberts, Vineland Station LOR 2E0	416-562-4142
Marketing	R.H. Cobbledick, Vineland Station LOR 2E0	416-562-4142
Nursery and Ornamentals	D.B. McNeill, 17 Wilson Dr. Milton L9T 3J7	416-878-2314

**Horticultural Research Institute of Ontario Staff*

For problems related to weeds, materials, crops or practices mentioned in this publication, contact the appropriate specialist listed above.

ONTARIO MINISTRY OF AGRICULTURE AND FOOD COLLEGES OF AGRICULTURAL TECHNOLOGY

Alfred College of Agricultural and Food Technology Alfred, K0B 1A0	613-679-2218
Centralia College of Agricultural Technology Centralia, N0M 1Y0	519-228-6691
Kemptville College of Agricultural Technology Kemptville, K0G 1J0	613-258-3411
New Liskeard College of Agricultural Technology New Liskeard, P0J 1P0	705-647-6701
Ridgetown College of Agricultural Technology Ridgetown, N0P 2C0	519-674-5456

AGRICULTURE CANADA RESEARCH STATIONS

Delhi Research Station Delhi, N4B 2W9	519-582-1950
Harrow Research Station Harrow N0R 1G0	519-738-2251
Smithfield Experimental Farm Box 340, Trenton, K8V 5R5	613-392-3527
Vineland Research Station Vineland L0R 2E0	416-562-4142

HORTICULTURAL RESEARCH INSTITUTE OF ONTARIO

Muck Research Station R.R. 1, Kettleby, L0G 1J0	416-775-3783
Simcoe Station Simcoe, N3Y 4N5	519-426-7120
Vineland Station Vineland L0R 2E0	416-562-4142

AGRICULTURE CANADA — PLANT PRODUCTS AND QUARANTINE DIVISION

Chatham	Room 206, Federal Bldg. P.O. Box 392 N7M 5K5	519-352-4290
Guelph	75 Farquhar St. N1H 6Z7	519-821-4160
London	Dominion Public Blvd. Box 325, Postal Stn. B N6A 4W1	519-679-4021
Ottawa	1400 Merrivale Road K2C 3N7	613-998-9926
Peterborough	Box 972, P.O. Bldg. K9H 2T0	705-743-2931
Toronto	160 Springhurst Ave. M6K 1C2	416-534-3553

PRECAUTIONS WITH PESTICIDES

1. Always read the label before opening pesticide containers, and follow all precautions and directions.
2. Never smoke, chew tobacco or eat while handling or applying pesticides. DO NOT carry such items in clothes used for spraying.
3. Always wear neoprene gloves to handle the concentrate. Wear a respirator to reduce pesticide inhalation especially when handling dusty formulations or volatile concentrates. Avoid inhaling spray droplets, dust or fumes by wearing a respirator.
4. Avoid spilling pesticides on skin or clothing.
5. Wear freshly laundered clothes each day.
6. Avoid contamination of water supplies, wells, ponds, streams etc. with pesticides when filling or flushing spray equipment. Never fill a sprayer directly from a stream or pond, unless the unit is equipped with an anti-backflow device to prevent siphoning.

IF ACCIDENTS OCCUR

1. If an accident occurs, remove contaminated clothing immediately, and wash contaminated skin thoroughly with soap and water. Wash clothing before reuse.
2. If clothing becomes wet with a pesticide when spraying, remove it immediately. When the spray operation is complete, remove contaminated clothes, have a bath or shower and put on freshly laundered clothing.
3. Clean up any pesticide spills immediately. Use dry soil or other absorbent material to remove excess liquid. If the spill is major, contact the nearest office of the Pesticide Control Service for advice (see list page 143).
4. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to hospital immediately. If possible, take a labeled container of the pesticide with you. (See Emergency Procedures for Pesticide Poisoning page 2.)
5. If a well becomes contaminated follow clean up instructions in OMAF Factsheet, *Pesticide Contamination of Farm Water Supplies*, Agdex 607.

SPECIAL INSTRUCTIONS

It should be emphasized that all pesticides are toxic and must be handled safely. In addition a number of pesticides (insecticides, fungicides and herbicides) have major deficiencies in their toxicological information because many tests that were conducted by the Industrial Biotest Laboratory (IBT) were invalid. Replacement studies are currently being conducted by the respective registrants. Those handling and applying these chemicals must pay special attention to the precautions outlined above.

At the time of publication, of the herbicides included in the *1983 Guide to Chemical Weed Control* recommendations, those requiring additional studies are as follows:

CSA COMMON NAME (Generic Name)	TRADE NAME	
allidochlor	**RANDOX**	Schedule 1
barban	**CARBYNE**	
chlorbromuron	**MALORAN**	Schedule 1
chlorpropham	**CIPC**	
cyanazine	**BLADEX**	
diquat	**REGLONE**	
glyphosate	**ROUND-UP**	
metobromuron	**PATORAN**	
metolachlor	**DUAL**	
paraquat	**GRAMOXONE**	
picloram	**TORDON**	
sodium chlorate	**ATLACIDE**	
terbuthylazine	**TOPOGARD**	
triallate	**AVADEX**	

Storage

1. Keep pesticides out of the reach of children, irresponsible persons, pets, and livestock. Store them in a room away from the home, food and feed and keep the room locked. Post pesticide storage area notices.
2. Un-rinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the drum it could be dangerous to other people handling it, or to the environment (for example, your water supply). Failure to rinse is also wasteful — why not use that 3% for the purpose for which it was purchased, i.e., to control the pest!

   Rinse all empty metal or glass containers three times with water and add washings to the spray tank. Or, use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic drum, and to rinse the residual left in the container directly into the spray tank. This procedure takes less than a minute and results in a rinsed container. The rinsed containers may be crushed, buried and covered by at least 50 cm of soil, away from any watercourse or water table.

   Rinsers are available from Phillips Farm Supplies, 96 Sanford St., Brighton, Ontario, K0K 1H0, telephone (613) 475-2040.

PROTECTIVE CLOTHING WHEN USING PESTICIDES OUTDOORS

1. When measuring and mixing pesticides, wear neoprene or rubber gloves, rubber boots, a protective apron or coveralls, and protective eyeshields.
2. Disposable gloves, aprons, overalls and hat covers are available at reasonable prices from the major safety supply companies.
3. Wash all clothing after use.
4. Wear a chemical respirator with dual cartridges when mixing and applying pesticides. Consult the following chart for proper selection. Never interchange components.

DUAL CHEMICAL CARTRIDGE RESPIRATORS RECOMMENDED FOR OUTDOOR PROTECTION FROM PESTICIDES (LISTED IN NUMERICAL ORDER ACCORDING TO NIOSH APPROVAL NUMBERS)

NIOSH APPROVAL NUMBER	APPROVAL ISSUED TO	RESPIRATOR NO. AND DESCRIPTION	COMPONENT NUMBERS	AVAILABLE FROM
TC-23C-54	Willson	122115 (2 sizes) (formerly Agritox 2)	R21 Cartridges R15 Filters	Safety Supply Co., Toronto
TC-23C-74	Norton	7549L 7549M 7549S (3 sizes)	N7500-21 Cartridges N7500-23 Filters N7500-27 Filter Cover	Norton Co., Safety Products Div., Toronto
TC-23C-78	3M	Powered Air Purifier (pesticide) White Cap Helmet Full-face	Cartridges Filters and Hood and Vest Kit	Safety Supply Co., Toronto
TC-23C-106	American Optical	R4058 R5058 R6058 (3 sizes)	R58A Filter/ Cartridges	AO Safety Products Div. of AOCO, Toronto
TC-23C-117	Scott	Scott Respirator 64-OVP Half-face (3 sizes)	642-OV Cartridges 642-F Filters	Safety Supply Co., Toronto
TC-23C-124	Safety House	236-G100-F 104	G100 Cartridges F104 Filters	Safety House of Canada, Toronto
TC-23C-148	MSA	460560 (3 sizes) Full-face	464025 Combination Cartridges	MSA of Canada, Downsview
TC-23C-178	Norton	75BP 49L 75BP 49M (2 sizes)	N-7500-21 Cartridges N-7500-23 Filters Back-pack	Norton Co., Safety Product Div., Toronto
TC-23C-190	Norton	7649L 7649M 7649S Silicone Full-face (3 sizes)	N-7500-21 Cartridges N-7500-23 Filters	Norton Co., Safety Product Div., Toronto
TC-23C-202	H.S. Cover (York)	MY 1482 G	100 Cartridges 104 Filters	Levitt-Safety Ltd., Toronto
TC-23C-224	Scott	Scott Respirator 65-OVP Full-face (2 sizes)	642-OV Cartridges 642-F Filters	Safety Supply Co., Toronto
TC-23C-238	American Optical	R7058 Full-face	R58A Filter/ Cartridges	AO Safety Products Div., of AOCO, Toronto
TC-23C-281	American Optical	R4563 R5563 R6563 (3 sizes)	R563A Filter Cartridges	AO Safety Products Div., of AOCO, Toronto

DUAL CHEMICAL CARTRIDGE RESPIRATORS (cont'd)

NIOSH APPROVAL NUMBER	APPROVAL ISSUED TO	RESPIRATOR NO. AND DESCRIPTION	COMPONENT NUMBERS	AVAILABLE FROM
TC-23C-282	American Optical	R7563 Full-face	R563A Filter Cartridges	AO Safety Products Div., of AOCO, Toronto
TC-23C-323	Survivair	2131-00 2231-00 2331-00 (3 sizes)	1001-00 Cartridge 1030-00 Filters	Levitt-Safety Ltd., Toronto

Additional information on protective equipment may be found in "Personal Protective Equipment for Pesticide Users", available at offices of the Pesticides Control Service, your pesticide dealer, and offices of the Ontario Ministry of Agriculture and Food.

PROTECTIVE CLOTHING WHEN USING PESTICIDES IN GREENHOUSES AND OTHER ENCLOSED AREAS

1. When measuring and mixing pesticides, wear neoprene or rubber gloves, rubber boots, a protective apron or coveralls, and protective eyeshields (unless a full-face mask is being used).
2. When the label calls for a full-face gas mask, use it. Be certain the correct canister is used.
3. Gas masks should fit tightly. Check by inhaling deeply after closing off the air intake; the mask should feel tight around the face. After use, remove the canister and wash the mask carefully with soap and water, rinse well, and dry carefully before storing in a clean, dry place.
4. When applying extremely toxic or highly toxic pesticides indoors, a full-face gas mask with correct canister may be used. Keep a fresh canister on hand as they lose their effectiveness after a certain time. However, a self-contained breathing apparatus (e.g. Scott's Air-Pac) is recommended for the application of this group of pesticides.
5. For methyl bromide a self-contained breathing apparatus, e.g., Scott Air-Pac, must be used for greenhouse work (available from Safety Supply Company, Toronto).
   a. **Dusting**
   Wear a good respirator or a full-face mask when the label calls for it.
   b. **Fogging Machines**
   Wear complete protective clothing. This includes a hat, jacket or pants or coveralls, rubber gloves, and an air-tight full-face mask.
   c. **Smoke Bomb**
   Wear a full-face mask when lighting the bombs and when aerating the house. Light the bomb farthest from the door and work towards the door. If bombs are placed in more than one path, more than one man should light them.
   d. **Soil Drenches**
   Pesticides used for this purpose are highly toxic. Use neoprene or rubber gloves, rubber boots, coveralls, respirator, and protective eye equipment.
   e. **Spray Applications**
   When spraying wear waterproof hat, jacket, and trousers worn outside of boots, neoprene or rubber gloves, and an air-tight full-face mask.

OTHER PUBLICATIONS ON CROP PRODUCTION WEED CONTROL AND RELATED TOPICS

Available from the Communications Branch,
Ontario Ministry of Agriculture and Food,
Legislative Buildings, Toronto, or from the
Agricultural Representative for the county.

49	Rid Ontario of Common Barberry and European Buckthorn
236	Safety Around Farm Buildings
296	Field Crop Recommendations
363	Vegetable Production Recommendations
505	Ontario Weeds (Price $2.50)
529	Weed Control in Lawns and Gardens

Factsheets
Poison-Ivy
Long-Term Weed Control Planning
Proso Millet

Available from Information Division,
Agriculture Canada, Ottawa

820 Poison Ivy
1482 Field Sprayers

Available from Canadian Agricultural
Chemicals Association, 116 Albert Street
Suite 710, Ottawa K1P 5G3

Pesticides and Their Safe Use (Price $1)

May be purchased from Publishing Centre,
Department of Supply and Services,
270 Albert Street, Ottawa K1A 0S9

948 Weeds of Canada (Price $3.50)

Available from Information Branch, Ontario
Ministry of the Environment, Pesticides
Control Section, Suite 100, 135 St. Clair
Avenue West., Toronto, Ontario M4V 1P5

Aquatic Plant and Algae Control
Pesticide Safety Handbook
Factsheet Aerial Extermination

THE METRIC SYSTEM

Linear Measures (length)

10 millimetres (mm) = 1 centimetre (cm)
100 centimetre (cm) = 1 metre (m)
1000 metres = 1 kilometre (km)

Square Measures (area)

100 m x 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)

Cubic Measures (volume)

Dry Measure

1000 cubic millimetres (mm^3) = 1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)

Liquid Measure

1000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight Measures

1000 milligrams (mg) = 1 gram (g)
1000 g = 1 kilogram (kg)
1000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Weight – Volume Equivalents

(1.00 kg) 1000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)

Dry – Liquid Equivalents

1 cm^3 = 1 mL
1 m^3 = 1000 L

CONVERSION TABLES – METRIC TO IMPERIAL
(approximate)

Length

1 millimetre (mm) = 0.04 inch
1 centimetre (cm) = 0.40 inch
1 metre (m) = 39.40 inches
1 metre (m) = 3.28 feet
1 metre (m) = 1.09 yards
1 kilometre = 0.62 mile

Volume (liquid)

1 millilitre (mL) = 0.035 fluid ounce
1 litre (L) = 1.76 pints
1 litre (L) = 0.88 quart
1 litre (L) = 0.22 gallon (Imperial)
1 litre (L) = 0.26 gallon (U.S.)

Weight

1 gram (g) = 0.035 ounce
1 kilogram (kg) = 2.21 pounds
1 tonne (t) = 1.10 short tons
1 tonne (t) = 2205 pounds

Pressure

1 kilopascal (kPa) = 0.15 pounds/square inch

Area

1 square centimetre (cm^2) = 0.16 square inch
1 square metre (m^2) = 10.77 square feet
1 square metre (m^2) = 1.20 square yards
1 square kilometre (km^2) = 0.39 square mile
1 hectare (ha) = 107,636 square feet
1 hectare (ha) = 2.5 acres

Volume (dry)

1 cubic centimetre (cm^3) = 0.061 cubic inch
1 cubic metre (m^3) = 1.31 cubic yards
1 cubic metre (m^3) = 35.31 cubic feet
1000 cubic metres (m^3) = 0.81 acre-foot
hectolitre (hL) = 2.8 bushels

Speed

1 metre per second = 3.28 feet per second
1 metre per second = 2.24 miles per hour
1 kilometre per hour = 0.62 mile per hour

Temperature

°F = (°C x 9/5) + 32
°C = (°F-32) x 5/9

Proportion

1 litre per hectare = 14.24 fluid ounces per acre
1 kilogram per hectare = 14.50 ounces avdp per acre
1 kilogram per square centimetre = 14.23 pounds per square inch
1 hectolitre per hectare = 1.10 bushels per acre

Application Rate Conversions (Metric to Imperial — Approximate)

litres per hectare x 0.09 = gallons per acre
litres per hectare x 0.36 = quarts per acre
litres per hectare x 0.71 = pints per acre
millilitres per hectare x 0.015 = fluid ounces per acre
grams per hectare x 0.015 = ounces per acre
kilograms per hectare x 0.89 = pounds per acre
tonnes per hectare x 0.45 = tons per acre

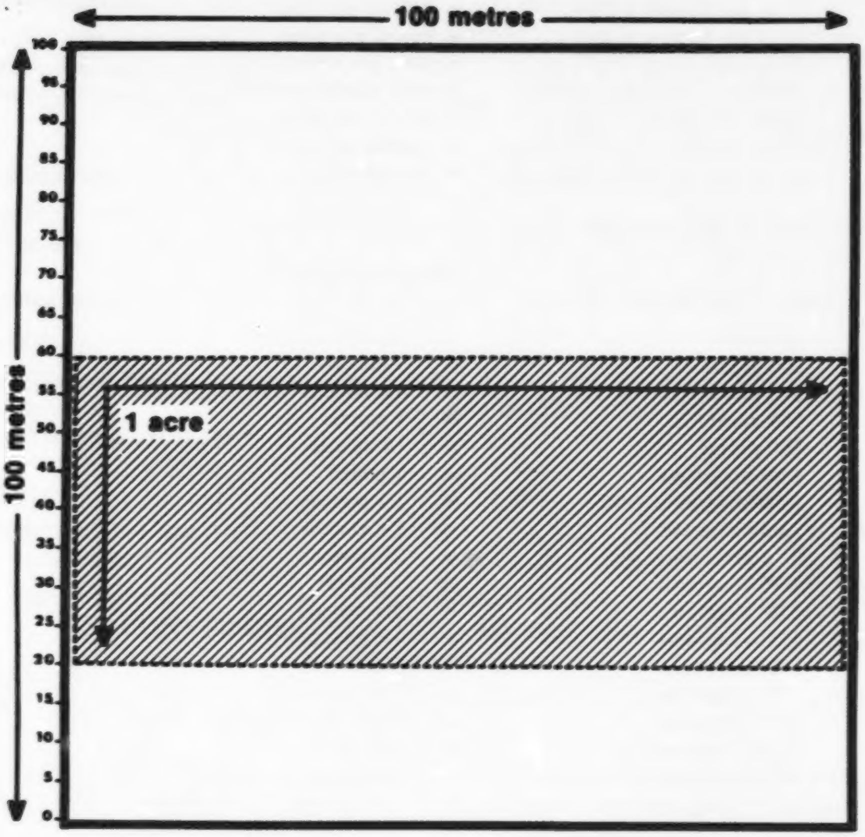
Dry Weight Equivalent

Grams, Kilograms/Hectare		Approximate Ounces, Pounds/Acre
100 grams	=	1½ ounces
200 grams	=	3 ounces
300 grams	=	4¼ ounces
500 grams	=	7 ounces
700 grams	=	10 ounces
1.10 kilograms	=	1 pound
1.50 kilograms	=	1¼ pounds
2.00 kilograms	=	1¾ pounds
2.50 kilograms	=	2¼ pounds
3.25 kilograms	=	3 pounds
4.00 kilograms	=	3½ pounds
5.00 kilograms	=	4½ pounds
6.00 kilograms	=	5¼ pounds
7.50 kilograms	=	6¾ pounds
9.00 kilograms	=	8 pounds
11.00 kilograms	=	10 pounds
13.00 kilograms	=	11½ pounds
15.00 kilograms	=	13½ pounds

Liquid Equivalent

Litres/Hectare		Approximate Gallons/Acre
50	=	5
100	=	10
150	=	15
200	=	20
250	=	25
300	=	30

HECTARE — ACRE PERSPECTIVE



100 m × 100 m = 10,000 m^2 = 1 hectare (ha)

1 hectare = 2.5 acres
2 hectares = 5.0 acres
3 hectares = 7.4 acres
4 hectares = 10.0 acres
5 hectares = 12.4 acres
6 hectares = 15.0 acres
7 hectares = 17.3 acres
8 hectares = 20.0 acres
9 hectares = 22.2 acres
10 hectares = 25.0 acres
20 hectares = 50.0 acres
30 hectares = 74.0 acres
40 hectares = 100.0 acres
50 hectares = 123.5 acres

1 acre = 0.4 hectares
2 acres = 0.8 hectares
3 acres = 1.2 hectares
4 acres = 1.6 hectares
5 acres = 2.0 hectares
6 acres = 2.4 hectares
7 acres = 2.8 hectares
8 acres = 3.2 hectares
9 acres = 3.6 hectares
10 acres = 4.0 hectares
20 acres = 8.0 hectares
30 acres = 12 hectares
40 acres = 16 hectares
50 acres = 20 hectares
60 acres = 24 hectares
70 acres = 28 hectares
80 acres = 32 hectares
90 acres = 36 hectares
100 acres = 40 hectares

METRIC APPLICATION RATES WITH AN ACRE PERSPECTIVE

Dry Weight

10 g/ha = 4 g/acre
20 g/ha = 8 g/acre
30 g/ha = 12 g/acre
40 g/ha = 16 g/acre
50 g/ha = 20 g/acre
100 g/ha = 40 g/acre
500 g/ha = 200 g/acre
1000 g/ha = 400 g/acre
1 kg/ha = 400 g/acre (0.4 kg/acre)
2 kg/ha = 800 g/acre (0.8 kg/acre)
3 kg/ha = 1.2 kg/acre
4 kg/ha = 1.6 kg/acre
5 kg/ha = 2 kg/acre
10 kg/ha = 4 kg/acre
20 kg/ha = 8 kg/acre
30 kg/ha = 12 kg/acre
40 kg/ha = 16 kg/acre
50 kg/ha = 20 kg/acre
100 kg/ha = 40 kg/acre
500 kg/ha = 200 kg/acre
1000 kg/ha = 400 kg/acre
1 tonne/ha = 400 kg/acre

Liquid Volume

10 mL/ha = 4 mL/acre
20 mL/ha = 8 mL/acre
30 mL/ha = 12 mL/acre
40 mL/ha = 16 mL/acre
50 mL/ha = 20 mL/acre
100 mL/ha = 40 mL/acre
500 mL/ha = 200 mL/acre
1000 mL/ha = 400 mL/acre
1 L/ha = 400 mL/acre (0.4 L/acre)
2 L/ha = 800 mL/acre (0.8 L/acre)
3 L/ha = 1.2 L/acre
4 L/ha = 1.6 L/acre
5 L/ha = 2 L/acre
10 L/ha = 4 L/acre
20 L/ha = 8 L/acre
30 L/ha = 12 L/acre
40 L/ha = 16 L/acre
50 L/ha = 20 L/acre
100 L/ha = 40 L/acre
500 L/ha = 200 L/acre
1000 L/ha = 400 L/acre

USE HERBICIDES

SAFELY

1. **Follow directions!** Read the instructions and follow precautions printed on the container labels.

2. **Protect the eyes** and avoid inhaling chemicals or prolonged exposure of the skin to the chemical. Take special care when the herbicide is labeled "poisonous".

3. **Sodium chlorate** constitutes a serious fire hazard. Mixtures such as Atlacide, Ercocide, etc. have fire-retardant additives and are safer to use. All chlorates are poisonous. See special precautions relating to the use of this chemical on page 19.

4. **2,4-D and related chemicals** may seriously damage crops of grapes, tomatoes, turnips, tobacco, beans, carrots, sugar beets, fruit trees, ornamental plants, and many others.
    a. Spray only on **resistant** crops. Before commencing, survey the area for the presence of desirable plants that might be damaged by the herbicide. There is a definite risk involved when spraying 2,4-D within 400 metres of a susceptible crop. However, if care is taken, areas closer than this may be sprayed under favorable conditions.
    b. Spray on calm days or when there is a light breeze away from the susceptible crop, and use as low a pressure as possible to reduce drift of the chemical. Use at least 100 L spray solution per hectare.
    c. Use the amine or low-volatile ester formulations to reduce the possibility of vapor drift.
    d. Use mechanical methods of weed and brush control where the spray risk is high.
    e. Use a special sprayer for herbicides such as 2,4-D. Such chemicals are almost impossible to remove from a sprayer and traces of them in other solutions may damage susceptible plants.

5. Mixtures of different herbicides or mixtures of herbicides with foliar fertilizers, insecticides, or fungicides should not be applied to crops in a single application unless recommended on the label or by competent authorities.

6. Do not store herbicides near fungicides, insecticides, fertilizers, or other agricultural chemicals.

7. Apply the herbicide properly, using the lowest recommended pressure.